JANUARY 1972

ELECTRONICS Australia

50c* Fiji 60c
Malaysia $2·40
New Zealand 60c

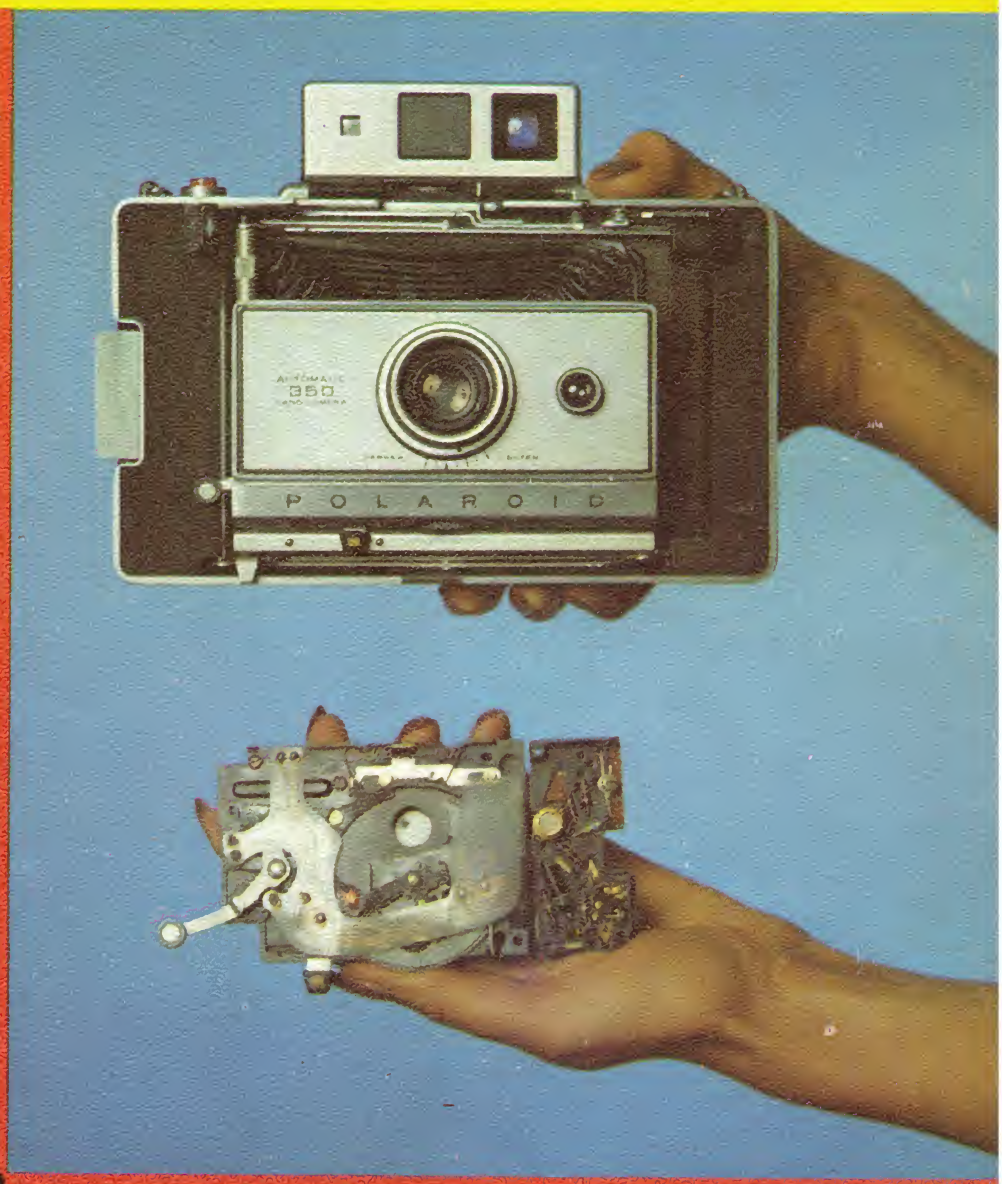
NEW IC STEREO AMPLIFIER PROJECT

Your Car: Build a Voltage Regulator

SPECIAL RECORD REVIEW SECTION

THE PI-COUPLER: HOW IT WORKS

Cover Story: New Cameras with Electronic Shutters



MORE FREE TRANSISTORS!

Simple circuits to use them

Registered for posting as a periodical — Category B

Monarch Amplification

You've probably saved enough money already.

Just when you thought you were still saving up for it, you find out that **Monarch** Amplification can be yours from as little as $107 (or up to $100 less than other amplifiers with the same performance).

Even so, the saving is just beginning—because when you get a really great amplifier at this price, you can spend more on those better speakers you've had your ear on.

Compare one of these **second generation** Monarchs with another, more expensive amplifier. Check the power, the frequency response and the distortion. Have a look at the features listed below, from slide controls and filters, to the satin walnut veneer cabinet.

How much? You've probably saved enough already.

Monarch SA-600
Recommended Retail Price $139.

The professional amplifier for perfectionists with a limited budget. 22 Watts per channel of clean, undistorted power, enough power for any speaker system. All silicon transistor circuitry means low noise. Harmonic distortion of 0.8% for transparent sound. Four slide controls for bass, treble, balance and volume. Main and remote speaker connections. High and low filter.

For your dollar the most flexible comprehensive amplifier on the market.

Monarch SA-450
Recommended Retail Price $107.

A feature-packed amplifier of very low cost to introduce the beginner to hi-fi performance.

Magnetic and crystal (for your old turntable) inputs. Tape monitor. Loudness and high filter control. Electronic fusing protects transistors. 8 watts per channel RMS. 3 slide controls. A "best buy" for the beginner.

Australian Distributors

W. C. Wedderspoon Pty. Ltd.

Showroom: 193 Clarence Street, Sydney. 29-6681

WD18/FP

ACT. Homecrafts, Petrie Street, Canberra. 2600

VIC. Douglas Trading, 191 Bourke Street, Melbourne. 3000

QLD. Tel-Air Electronics, 187 George Street, Brisbane. 4000.

W.A. Leslie Leonard, London Court, Perth. 6000

TAS. P&M Distributors, 87 Brisbane Street, Launceston. 7250

S.A. Sound Spectrum, 33 Regents Arcade, Adelaide. 5000

ABC certified circulation in excess of 48,000

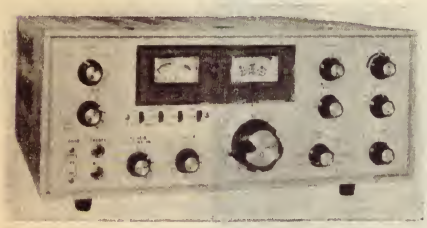
Readership in Sydney, Melbourne, Brisbane, Adelaide and Perth 211,000 (McNair National Readership Survey, May-September 1971)

ELECTRONICS Australia

Incorporating "RADIO, TELEVISION and HOBBIES" and "MODERN WORLD"

AUSTRALIA'S LARGEST-SELLING ELECTRONICS & HI-FI MAGAZINE

VOLUME 33, NO 10



TARIFF CONTROVERSY: Why should this Yaesu Musen transceiver have to carry a high level of import duty? The question of tariffs applied to amateur gear is discussed again in Forum starting on page 52.

IC AMPLIFIER: Want to build a simple economical amplifier using an IC? An up-dated version of the Playmaster 129 stereo amplifier is described on page 34.

FREE TRANSISTOR: A coupon to obtain a free transistor appears on page 75. Five simple circuits which you can build using this transistor are described in the article beginning on page 72.

On the cover

The Polaroid Automatic 350 camera on our cover contains two electronic timing circuits. One determines exposure time and controls the shutter; the other determines development time and operates an audible "beep" signal. See also page 12.

CONTENTS — JANUARY, 1972

world of electronics and hi-fi

projects and technical

regular features

The Philips resistor.

PHILIPS

□ High stability □ Low noise □ Long life

Why settle for moulded
composition when you can get the
superior quality of Carbon Film Fixed
Resistors at even lower prices!

THE ELCOMA DIVISION
Electronic Components & Materials
Philips Industries Limited.
Sydney • Melbourne • Brisbane
Adelaide • Perth • Canberra • Hobart

PHILIPS

38.1402

EDITORIAL VIEWPOINT

Technical education: call for a truce

In Australia as in many other countries there is a long-standing and now almost traditional antagonism between academics involved in the education and training of scientists and engineers, and industrialists seeking trained technical personnel. It has become the expected thing for spokesmen from each "side" to launch periodic volleys against the policies or practices of the other.

Frequently there are complaints from industry that the universities and colleges are not designing their courses with sufficient orientation towards the needs of industry; that they place too much emphasis on "pure" science and mathematics, and on broadening student outlook with "humanities" subjects, at the expense of vocational training; and that their courses are not keeping pace with current developments.

Educationalists in their turn criticise industry for not defining its requirements accurately enough, for taking too narrow and short-sighted a view of the training it believes is required, and for failing to make proper use of graduates, diplomates and other qualified people.

As with so many other problems, at least part of the cause seems to lie in faulty communication. With so many well-qualified and capable people on both sides, surely most of the problems could be solved by a determined effort to get together and thrash them out.

The point is, of course, that criticism can be offered so easily. All it needs is a sense of grievance and an opportunity to voice that grievance in public or in one of the media. Purposeful debate and investigation is much more difficult to arrange. Busy people have to set aside existing commitments to meet in common forum. They must be willing to submit their convictions for examination and possible rejection.

An illustration of just what can be achieved in this way was given by a recent experiment carried out at York University in Britain. A dozen scientists from the industrial giant ICI were brought together with an equal number of educationalists in an intensive "think tank" situation. In the space of only three and a half days they were able to produce no less than eight 16-page segments of a modern textbook on industrial science.

It seems to me that this idea could be taken a good deal further. Why not encourage a great many more experienced scientists and engineers working in industry to serve as part-time academics, by making it possible for them to do this without suffering financially or disturbing their career? Provision could also be made for full-time lecturers and technical teachers to obtain in-service training in industry.

There is little to be lost by examining these possibilities, and a very great deal to be gained.

—Jamieson Rowe

ON SALE THE FIRST MONDAY OF EACH MONTH

Printed and published by Sungravure Pty Ltd, of Jones Street, Broadway. at Morley Avenue, Rosebery, Sydney.

*Recommended and maximum price only

Editorial Office
12th Floor, 235-243 Jones Street, Broadway, Sydney, 2007. Phone 2 0944. Postal Address: Box 2728, GPO, Sydney 2001.

Advertising Offices
Sydney — 8th Floor, 235-243 Jones Street, Broadway, Sydney, 2007. Phone 2 0944.
Sydney representative: Bill Summons.
Melbourne, — 374 Little Collins Street, Melbourne, 3000. Phone 67 7021.
Melbourne representative: Jeffrey Byrne.
Adelaide — Charles F. Brown & Associates Ltd, 429 Pulteney Street, Adelaide, 5000 Phone 23 1657.
Adelaide representative: Tom Duffy.
Perth — 454 Murray Street, Perth, 6000. Phone 21 8217.
Perth representative: Jack Hansen.

Representation
Melbourne — Sungravure Pty Ltd, 392 Little Collins Street. Phone 67 7021.
Brisbane — Sungravure Pty Ltd, 78 Elizabeth Street. Phone 21 6690.
Adelaide — Sungravure Pty Ltd, 104 Currie Street, Phone 51 3502.
Perth — Sungravure Pty Ltd, 454 Murray Street. Phone 21 8217.
Newcastle, NSW — Associated Newspapers Ltd, 22 Bolton Street, Phone 2 3696.
London — John Fairfax and Sons (Aust) Ltd, Reuter Building, 85 Fleet Street.
New York — "The Sydney Morning Herald" Ltd, 1501 Broadway, New York NY 10036.

Subscriptions
Rates and order form given on page 126.

Circulation Office
9th Floor, 235-243 Jones Street, Broadway, Sydney, 2007. Phone 2 0944.

Distribution
Distributed in NSW by Sungravure Pty Ltd, Jones Street, Broadway, Sydney; in Victoria by Sungravure Pty Ltd, 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty Ltd, 104 Currie Street, Adelaide; in Western Australia by Sungravure Pty Ltd, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Davies Bros Ltd, Macquarie St, Hobart; in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

INSTROL

PLAYER STANDS AND PERSPEX COVERS

MODEL 65 STAND

An attractively designed de-luxe stand which is complete with hinged perspex cover. Styling of the stand includes raised side panels (2½" above player panel) and a raised rear panel (1¾" above player panel). The grey tinted perspex cover features a perspex knob and measures (internal) 16⅝" x 13¾" x 4¾", Below shelf clearance is 3".

Maple / Walnut stand	*$28.00*
Teak stand	*$28.50*

MODEL 45 STAND WITH 415 COVER

PERSPEX COVERS

MODEL 315. Size 14¼" x 15¼" x 3¾" outside measurements. This sleek MOULDED cover in grey tinted perspex is for use with the model 35 stand and any record player. Complete with attractive perspex knob.

MODEL 325. Size 14¼" x 15¼" x 4¾" outside measurements. A fabricated grey-tinted cover, ideal for record changers in conjunction with model 35 stand. Complete with attractive perspex knob.

MODEL 415. Size 17¾" x 14¾" x 3¾" outside measurements. This attractive MOULDED grey-tinted cover is for use with the model 45 stand and any record player. Complete with sleek perspex knob.

MODEL 425. Size 17¾" x 14¾" x 4¾" outside measurements. A fabricated grey-tinted cover, ideal for changer models in conjunction with our No. 45 stand. Complete with attractive perspex knob.

Model 315	*$9.50*	Model 415	*$10.50*
Model 325	*$10.50*	Model 425	*$11.50*

(Extra for set of stay-up type hinges 80c)

MODEL 75 COMB' STAND

COMBINED AMP / PLAYER CABINET

This model 75 cabinet combines a player stand, attractive tinted perspex cover and amplifier cabinet (4½" x 17¼"). Perspex cover comes complete with attractive perspex knob and a pair of stay-up type hinges. Cover measures 16⅝" x 14⅛" x 4¾" inside dimensions. The cabinet comes as an easy-to-assemble kit of parts, both saving you money and facilitating transport. (Player panel cut to template is $1.00 extra).

Kit of parts in Maple	*$29.50*
Kit of parts in Teak	*$30.50*

MODEL 35 STAND WITH 325 COVER

PLAYER STANDS

MODEL 35 STAND. Size 14½" x 15⅜" x 3¼". Complete with masonite base, rubber legs, fully veneered on all surfaces. Features attractive side panels raised by ⅛" from player panel.

Walnut or Maple	**$11.00**
Teak	**$11.50**

MODEL 45 STAND. Size 17⅞" x 14⅞" x 3½". Complete with special black surround on the base, plus a masonite safety base. Fully veneered on all surfaces. Sweeping new overseas styling.

Walnut	**$11.50**
Teak	**$12.00**

(Prices include cutting to suit template)

PACKING AND REGISTERED POSTAGE

MODEL	N.S.W.	VIC. & QLD.	S.A., TAS. NT. NG.	W.A.
Player stand	1.85	2.10	2.55	3.40
Perspex cover	1.85	2.00	2.40	3.20
No. 65 stand	3.80	4.35	5.30	7.20
No. 75 kit	3.10	3.65	4.60	6.50

COMPLETE HI-FI CATALOGUE & PRICE LIST . . . ONLY 50c

Contains full specifications, retail pricing and discount pricing on the following items:—

Turntables, Player Stands and Perspex Covers, Cartridges and Stylii, Amplifiers, Amplifier Kitsets, Tuner Kitsets, Separate Speakers, Speaker Systems, Speaker Enclosures, Speaker Kits, Tape Decks, Tape Recorders, Record Storage Cabinets and Kits, Equipment Cabinets (Built and Kits) for HiFi, Hi-Fi Accessories, Guitar Amplifiers and Guitar Speaker Systems (Built and Kits), Test Equipment Kitsets, Technical Books, Instrol Products, etc.

Please send me the following Player Stands, Perspex Covers, and / or J. H. Amplifier. (Post is not applicable for J. H. amplifier.)

NAME .....

ADDRESS .....

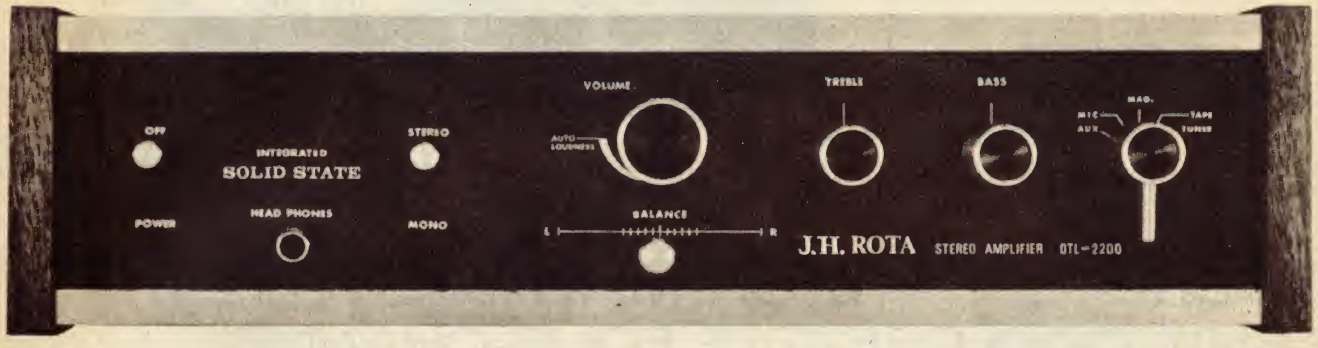
..... P.C. .....

E201

INSTROL

presents the new

J. H. AMPLIFIER



The only amplifier that combines the benefits of Australian research with Japanese Technology:—

The New J. H. ROTA OTL-2200

This amplifier has been designed utilizing both the Australian expertise of "J. H. Reproducers Co." and the technological facilities of the giant "Rota Corporation" of Japan.

CHECK THESE FEATURES.

INPUTS: Magnetic Cartridge (4mV); Microphone (5.5mV); tuner (200mV); tape (200mV); crystal or high output ceramic cartridge (200mV).

OUTPUT POWER: 40 watts total music power (2 channels) or 12 watts RMS per channel.

TOTAL HARMONIC DISTORTION: Below 0.2% up to 30 watts.

OUTPUT IMPEDANCE: 4-16 ohms.

FREQUENCY RESPONSE: 20-40,000Hz ± 1dB.

TONE CONTROL: Bass ± 10dB at 100Hz.
Treble ± 10dB at 10,000Hz.

S/N RATIO: Mag. & Mic, better than 60dB.
Aux. & Tape, better than 75dB.
Tuner, better than 70dB.

STYLING: Attractive black aluminium fascia in polished walnut cabinet.

ALL THIS FOR ONLY $110.00

(MUCH LESS WITH TRADE-IN)

the amplifier will be sent "freight free" to anywhere in Australia.

INSTROL

HI-FI & ELECTRONICS CENTRE

91A YORK ST. (between King & Market Sts.),
SYDNEY, N.S.W. 2000. Phone 29 4258

Please send me the following player stands, perspex covers, and or J. H. Amplifier. (Post is not applicable for J. H. Amplifier.).

..... at $..... plus post $.....

..... at $..... plus post $.....

..... at $..... plus post $.....

I enclose my money order / cheque for $ .....

NAME .....

ADDRESS .....

..... P.C. .....

E201

SURROUND
SONIC
STEREO SOUND

444

DISCRETE TYPE OR MATRIX SYSTEM……
KENWOOD CREATES FOUR-CHANNEL CIRCULAR IMPACT

424

DAMPED PIPE DUCT
4-WAY 5-SPEAKER SYSTEM KL-5080

SURROUND SONIC STEREO
TAPE DECK KW-6044

NEW

80-WATT (IHF 8Ω)
SOLID STATE STEREO
AMPLIFIER KA-4002

4-CHANNEL/IDS
MULTI PURPOSE AMPLIFIER KA-3344

Surround Yourself Sonically With KENWOOD Creativity— KW-6044, KA-3344, KA-4002, KL-5080 Four Channel System

KENWOOD's 4-channel reproduction as exemplified by the KW-6044 surround sonic stereo tape deck is highlighted by an especially-designed playback head. This head produces ultra-high signal to noise ratio performance with the advantage of extra frequency response. Because of its 4 independent preamplifiers, the KW-6044 offers complete playback of discrete type 4-channel tape. Add the KA-3344 surround sonic quadrix amplifier, the 80-watt KA-4002 solid state stereo amplifier and the 70-watt KL-5080 4-way, 5-speaker system and you have a complete surround sonic system.

SPECIAL FEATURES OF KA-3344

• 4-channel Reproduction: The KA-3344 includes the newly developed KENWOOD method 4-channel matrix circuitry and stereo main amplifier. • Dynamic Power Output (IHF): 30W at 4 ohms. • Dimensions: 16-1/4"(W), 4-3/4"(H), 12.0"(D).

SPECIAL FEATURES OF KW-6044

• 4-channel Reproduction: The KW-6044 is capable for the complete playback of discrete type 4-channel tape as it has 4 independent preamplifiers. • Number of Heads: 3 heads: 4 Track 2 channel Erase, 4 Track 2 channel Record, 4 Track 4 channel Playback. • Dimensions: 16"(W), 15-1/2"(H), 7"(D).

SPECIAL FEATURES OF KL-5080

• Tone Selector: Built in 3 step tone selector, Multi-channel amplifier system connection terminals. • Dimensions: 15"(W), 25-1/2"(H), 11-5/6"(D).

SPECIAL FEATURES OF KA-4002

• Dynamic Power (IHF): Both ch. at 4 ohms: 80 watts. • Frequency Response: Main input: 15-50,000Hz 1.5dB. • Dimensions: 13"(W), 4-4/8"(H), 9-7/16"(D).

For Rear Speakers:
2-WAY 2-SPEAKER SYSTEM
KL-220

the sound approach to quality

KENWOOD

TRIO ELECTRONICS, INC.

6-5, 1-CHOME, SHIBUYA, SHIBUYA-KU, TOKYO, JAPAN

Sole Agent in Australia: **Jacoby Mitchell Limited: Head Office:** 215 North Rocks Road North Rocks, Sydney, N.S.W., 2151 Tel: 630-7400 **Melbourne:** 155 Abbotsford Street North Melbourne Tel: 30-2491 **Brisbane:** 56 Edward Street Tel: 2-6467 **Adelaide:** 652 South Road, Glandore Tel: 53-6117 **Perth:** Jayem Electronics, 252 William Street Tel: 288102 **Tasmania:** K.W. McCulloch Pty., Ltd., 57 George Street, Launceston Tel: 25-322 **Newcastle:** Edmunds Moir & Co., Pty., Ltd., 18 Wood Street Tel: 61-4991
Distributor in New Zealand: JOHN GILBERT & CO., Tasman Buildings, Anzac Ave., Auckland, C.1.

FREE CATALOG

To : Jacoby Mitchell & Co., Ltd. EA
469-475 Kent St., Sydney

Send me information on KENWOOD 4-channel system & name of nearest KENWOOD retailer.

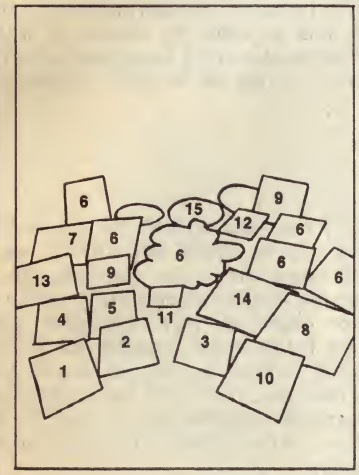
NAME _____ **AGE** _____

ADDRESS _____


"All the best
SATURDAY
1
JANUARY
1972
DECEMBER, 1971
FEBRUARY
New Year's Day
blic Holiday observed in all Sta
or now I am in a holiday humou

from Goldring"

Start the new year with a resolution to use only the best accessories for your sound equipment —proven quality accessories from Goldring. Goldring gives you more than just quality accessories. Each product is backed by years of experience and technical knowledge in sound.
Look for the Goldring Accessories stand at your favourite retailer.



1. **GTA: 15** Goldring leader tape.
2. **GTA: 25** Goldring tape clips.
3. **GTA: 18** Goldring Head cleaning tape.
4. **GTA: 24** Goldring Record center.
5. **GTA: 28** Goldring Record Spider (5).
6. **Goldring** Audio Connecting leads—wide variety.
7. **GTA: 18** Goldring Head cleaning fluid.
8. **GTA: 11** Goldring Tape Recorder Heads and guides lubricant.
9. **GTA: 26** Goldring Magnetic Earphone 20' lead.
10. **GTA-14** Goldring ¼" Splicing Tape—120" long.
11. **GTA-19** Goldring Recording Tape Splicer.
12. **GTA-21** Goldring 5 Pin Din to 5 Pin Din—Audio Connecting Leads.
13. Goldring Cassette Cleaner—cleans heads ensuring maximum fidelity.
14. **GTA-12** Goldring Twin-pak Tape Kit; Head Cleaner and Lubricant.
15. Goldring 5" and 7" empty spool.

Fill your new year with sound from Goldring Engineering (A'Asia) Pty. Ltd.

available from all leading retailers.

GOLDRING
Engineering (A'asia) Pty. Ltd.

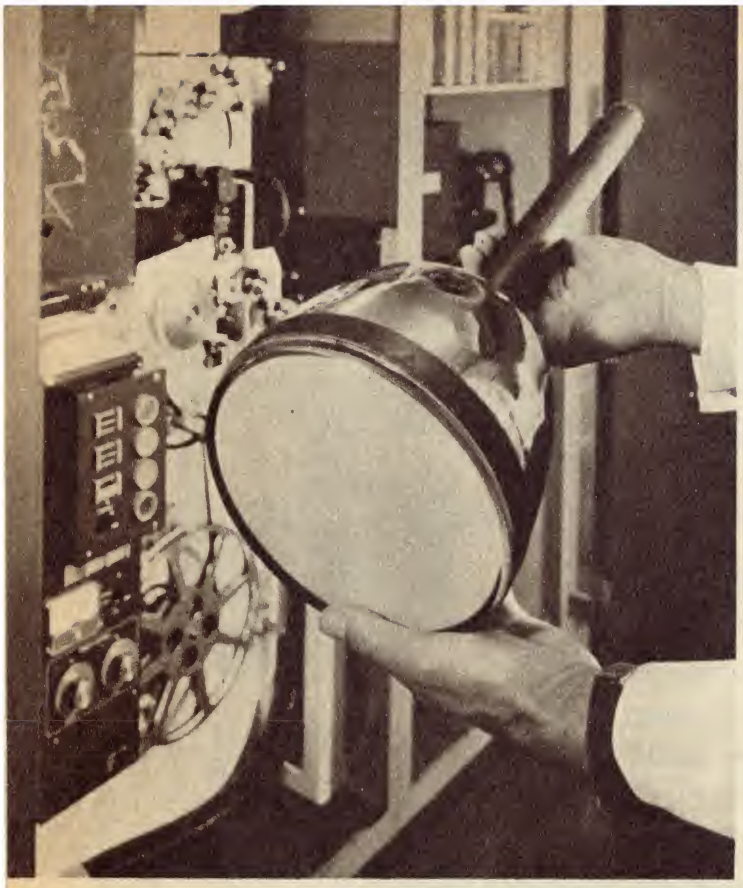
New South Wales: 26 Ricketty Street, Mascot 2020. Telephone 67 6088. **Canberra:** 19 Molonglo Mall, Fyshwick, A.C.T. 2604. Telephone 95 8248. **Victoria:** 162 Pelham Street, Carlton 3053. Telephone 347 5177. **Queensland:** 32 Balaclava Street, Woolloongabba 4102. Telephone 91 4972. **South Australia:** 207 Flinders Street, Adelaide 5000. Telephone 23 3488. **Western Australia:** 32 Northwood Street, Leederville 6007. Telephone 8 4988.

For further obligation free information and technical literature clip coupon and post to your nearest Goldring office.

Name.....

Address.....

I require information on



CRT for flying spot scanner. (Top left.) A new high brightness cathode ray tube has been developed in the UK by EMI Electronics Ltd especially for scanning negative colour film in 35mm and 16mm scanners. The tube, type MX69, uses a new phosphor of extremely fine texture (2 to 5um grain size) settled by a special process to avoid clumping, giving a screen with negligible noise. Its brightness is nearly twice that of conventional zinc oxide tubes under focused conditions with equal supply voltages. It gives, therefore, very satisfactory performance at reduced voltages with reduced x-radiation. The phosphor has much less change of brightness with focus than zinc oxide, and hence shading due to slight change of focus is minimised. The MX69 can also be used for positive film scanning with an increase of about 10dB signal / noise ratio in all colour channels.

CCTV at Tullamarine. (Centre.) Some 50 television monitors are in use at the Trans-Australia Airlines (TAA) terminal at Tullamarine Airport, Melbourne, to display essential data of TAA aircraft timings, location, flight details, and service control. A comprehensive closed circuit television system, fed by a computer, has been installed for this purpose by AWA-Rediffusion, and provides 70 outlets to which monitors can be connected. The operator in the foreground uses the TV displays to answer public inquiries on aircraft arrivals and departures.

Portable calculator. (Below left.) The Anita portable battery / mains operated electronic calculators, models 1000B and 1011B, use a rechargeable battery with 4-5 hours continuous operating life. A warning light is displayed when one hour's life remains. To conserve battery life, a figure remains on display for only 13 seconds, after which it will blink although the figure is still available for further processing. The calculator can add, subtract, multiply and divide, with a constant factor facility in all functions. The 1011B has, in addition, automatic percentage and round-off facilities, and a store to accumulate individual results. (Sumlock Comptometer Ltd, Rockingham Road. Uxbridge, Middx, England.)

Hong Kong space link. (Below.) Princess Anne officially opened a space communications station, named Hong Kong II, during a recent visit to the colony. This picture was among the first to be transmitted from the station after the ceremony. Also in the photograph are Mr. Edgar G. L. Howitt (centre), managing director of Cable and Wireless, and Mr. Brian Suart, general manager of the Hong Kong branch of the company. Hong Kong II, built by Marconi Communication Systems for Cable and Wireless, provides communication and TV links with Europe via the Intelsat III satellite over the Indian Ocean.

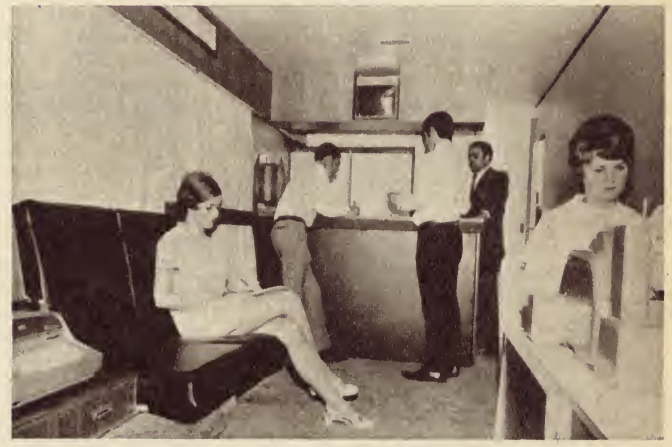
ELECTRONICS PICTORIAL

Special events centre. A mobile special events centre will be loaned by Rothmans for use at an inter-state carnival to be held in Brisbane in March. At first glance, the 45ft long, 9½ ton unit (lower centre) appears to be a mammoth advertisement for the tobacco company. But inside the vehicle many Post Office communication facilities have been installed for use by news organisations covering major events.

It contains a broadcasting studio, a teleprinter, wire-photo transmitter, closed circuit television, telephones, refrigerators, work tables for the press, a public address system, walkie-talkie sets, facilities for TV camera crews, and a 21ft long meeting room. Rothmans also provides a quarter-plate press camera with film supplied, and a fully equipped dark room is built into the unit. The upper centre photograph shows a general view of the interior of the unit, while the upper photograph shows Mr Jeff Sunderland, of radio station 4BK Brisbane, on the air direct from the studio at a recent event.

British hovertrain. (Below right.) Britain's first prototype hovertrain has undergone static tests on its trial track (a concrete girder) at Tracked Hovercraft Ltd, Earith, Hunts, England. The first trial run was scheduled to take place late in November. The design of the 73ft long vehicle, called the RTV31, called for a wind-tunnel tested aerodynamic shape capable of withstanding the high stresses normally associated with aircraft, but much more rigid. It will be supported and guided astride its concrete track by air cushion jets and propelled by a linear induction motor. The vehicle was designed and built by Vickers Ltd, Swindon, Wilts, for Tracked Hovercraft, who is carrying out a research program as a subsidiary of the British National Research Development Corporation.

Pushbutton communications. (Below.) A non-switching unit (NSU) telephone communication system, designed by E. S. Rubin & Co Pty Ltd, has been installed in the Sydney offices of Hughes Motor Service. The latter company operates more than 60 hire cars and chauffeur-driven vehicles in the Sydney area, and installed the system to handle increased traffic. The NSU is a custom-designed multi-circuit equipment which provides a wide range of facilities. It provides six incoming lines and six positions to hold calls on these lines, six intercom lines linking various departments within the group, and eight push-button direct lines to regular clients. (E. S. Rubin & Co Pty Ltd, 73 Whiting Street, Artarmon, NSW 2064.)



Electronic camera shutters

by DICK LEVINE

Automatic exposures by candlelight, high accuracy and an infinite number of shutter speeds — these are some of the advantages of electronic camera shutters.

During the past 10 years we have seen a strong move in the camera industry toward what is commonly called "electric eye" photography. This development has been welcomed by those who just want to "aim and shoot" and let the camera take care of the technical problems.

It has even been appreciated by many advanced amateur photographers who find it convenient having one less variable to worry about.

Professional photographers, however, have tended to resist camera automation because past automatic cameras have not allowed a choice of preselecting either aperture or shutter speed on the same camera.

Most automatic exposure cameras have made use of a form of aperture control rather than shutter control. This was a logical development from camera-mounted light meters, which were eventually integrated into the camera body. The most common arrangement (see illustration) is either spring powered or operated by the action of pressing the shutter release button.

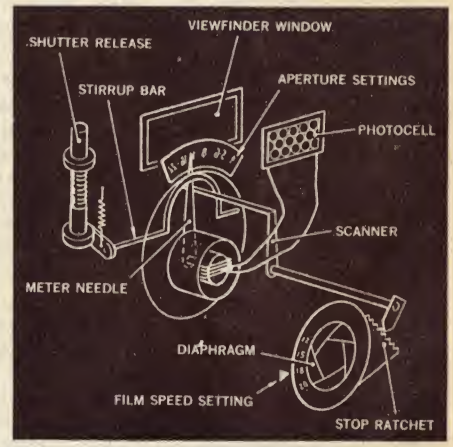
A stirrup bar is used to hold the light meter needle briefly while a scanning lever mechanically senses its position. The diaphragm is then adjusted by a spring and ratchet device to make the aperture agree with the f-stop reading on the meter.

In other words, except for the photocell and meter movement, aperture control systems are mechanically operated. If the photocell is the type which generates its own power, such as a selenium cell, the camera need not have a battery supply. This type has been used most often on fixed-lens cameras. Single lens reflex cameras with interchangeable lenses usually contain the light-dependent resistor (LDR) type photo cell, which has the advantage of smaller size and can be mounted inside the pentaprism housing. LDR systems, however, need an internal battery.

Electromechanical aperture control systems, though complex mechanically, have been refined to the point where they have a high degree of reliability — but they are still somewhat susceptible to damage due to rough handling and sometimes have problems in extremely cold weather.

Another disadvantage is that, since they are adjusting aperture rather than time their usefulness at low light levels is limited by the maximum aperture available on the camera.

The alternative to aperture control is the electronic shutter concept, which is rapidly gaining acceptance by the general public. The pioneers in the electronic shutter field are Polaroid and Yashica. Polaroid has used electronic shutters since the introduction of its first automatic camera in 1963. Polaroid's electronic shutter was built by Yashica, and in 1964, Yashica brought out their own electronic shutter camera.



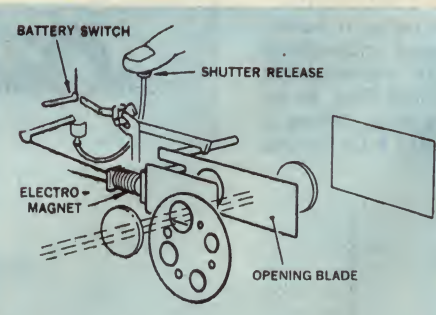
Electromechanical aperture control mechanism.

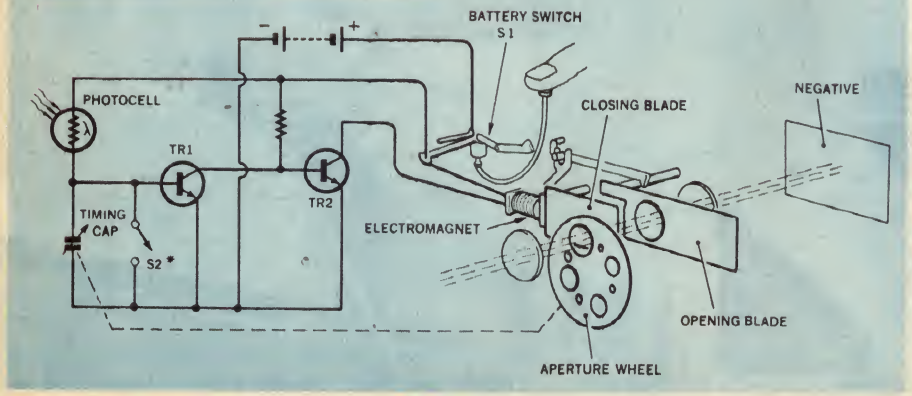
Though the cameras were very different, both used a similar shutter control concept. Both cameras use a timing capacitor which starts charging when the shutter release is pressed, and both control the shutter action with an electromagnet.

As you can see in the accompanying illustration, the Polaroid shutter is a simple device, using only two transistors, a photocell, and a few minor components.

Its sequence of operation, which can take place in a little as 1 / 1200 of a second, is as follows: When the shutter is cocked, both blades are mechanically pulled to one side of the light path. Part of the opening blade remains between the lens elements to prevent light reaching the negative. When the shutter release is pressed to take a photograph, battery switch (S1) closes and activates. TR2. The base of TR2 is forward

Sketch at right shows the Polaroid shutter mechanism just prior to pressing the shutter release. Drawing below shows the closing blade being held by the electro-magnet while the timing capacitor charges.





Colorpak 80 is a low priced Polaroid colour camera with an electronic shutter.

biased by the resistor, current flows in its collector circuit, and the electromagnet is energised.

The opening blade is released mechanically and snaps across to permit light to reach the negative through a large hole in the blade. The closing shutter is also mechanically released, but cannot move because it is restrained by the electromagnet. At the same time as the blades are released, timing switch S2 opens, permitting the timing capacitor to start charging.

When the timing capacitor has charged to a level sufficient to bias TR1 into conduction, TR1 effectively "steals" the forward bias from TR2, causing TR2 to stop conducting. With TR2 turned off, there is no current through the electromagnet and the closing blade is released to complete the exposure.

The timing capacitor's rate of charge will be determined by two things: the amount of light striking the photocell during its charge cycle, and its total capacitance. There are several timing capacitors and these are switched in and out out of circuit in various combinations by a switch mechanically coupled to the aperture wheel.

It is interesting to speculate as to why Polaroid designers decided in favour of a solid state shutter control as long ago as 1963, when other camera manufacturers were almost unanimously choosing aperture controls which were mechanically coupled to light meters. Polaroid designers were in a rather unique postion, however, in that they had only four film speeds to contend with, so they could dispense with the diaphragm-type aperture control.

Also, one of those film speeds was 3000ASA, meaning that with a bright scene and the f-stop set at its minimum of f42, the shutter had to close in 1/1200 of a second. So they were faced with having to provide a fast, accurate shutter in any case, and their design proved to be much simpler mechanically than a diaphragm system.

Currently available Polaroid models that contain the electronic shutter are the four cameras in the Automatic 300 Land series, ranging in price from $75 to $185, and the new Colorpak 80 camera which sells for less than $30.

Another interesting feature of Polaroid's top-of-the-line Automatic 350 model (shown on our cover) is the inclusion of an all-electronic timer with an audible "beep" signal to notify the user that the exposed film has been developed.

As with the shutter mechanism, the "beeper" circuit uses a capacitor as a timing device. The timing required is set by means of a dial on the back of the camera which controls a variable resistor in series with the timing capacitor.

The action of removing the exposed picture from the camera momentarily closes a two-pole normally open switch. One set of contacts temporarily shorts out the timing capacitor to get rid of any residual charge; the other set activates a circuit which turns on a small indicator lamp.

When the capacitor is fully charged, circuits are activated which turn on the "beeper" transducer and turn off the lamp, indicating the development is complete. The lamp driver circuit and the "beeper" circuits are combined on a single IC device.

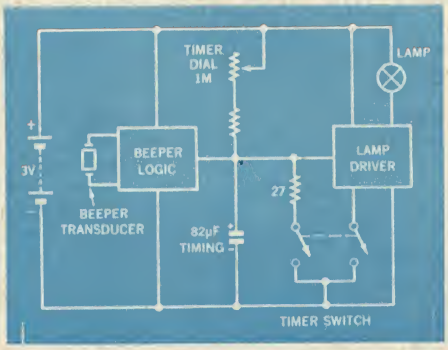
Yashica's first electronic shutter model to be sold in Australia was the Electro 35, which was introduced here in 1966. It was initially advertised as the camera with an "electronic brain", a description which caused it to sell very slowly at first because the general public was afraid it was too complicated and might be costly to repair.

Only after an extensive campaign to convince the public that an electronic shutter camera was simple to operate and more robust than an automatic aperture camera, did buyers begin to accept the concept. But what really caught the public's fancy was the discovery that perfectly timed exposures can be taken indoors without flash — even by candlelight. And the depth-of-field can be adjusted, even at low light levels, because small apertures can be compensated for by shutter speeds as slow as two or three seconds.

In addition to the Electro 35, which has a between-the-lens shutter, Yashica has recently introduced an advanced 35mm single lens reflex camera with a metal focal plane shutter and a wide range of high speed interchangeable lenses.

They have combined the electronic shutter circuits of the Electro 35 with a unique electronic exposure readout system to create a semi-automatic camera which retains the versatility of a manual camera, but is virtually automatic due to the ease with which the exposure can be read and programmed into the shutter circuit.

This model, called the Yashica TL Electro-X, is ideal for indoor still life photography because the scene can be viewed exactly as it will appear on film, and



Functional block diagram of Polaroid's "beeper" circuit.

depth-of-field adjustments can be made through the stopped-down diaphragm. Since the CdS photocells are behind the lens and the exposure readout system operates when the diaphragm is stopped down to the selected f-stop, extremely accurate shutter speeds can be achieved.

The electronic shutter will operate at any speed between 1/1000 second and 2 seconds. If, for example, lighting and depth-of-field requirements dictate a shutter speed of 1 103.6 second, that is exactly the speed at which you would set the shutter dial.

Obviously one couldn't read a light meter to that degree of accuracy, so the camera provides exposure readout in the form of lighted red arrows just beneath the viewing screen.

If the exposure is too low for the film speed and aperture being used, the arrow

Yashica TL Electro-X.

pointing to the left comes on, indicating the correct direction to turn the shutter dial to compensate. For an overexposure condition, the right-pointing arrow comes on. When both arrows are off, the exposure is correct. The camera can be brought to the correct exposure by adjusting either aperture or shutter speed, meaning that either parameter can be preselected to suit conditions.

The readout circuit and the shutter circuit are integrated so that as the shutter speed dial is adjusted to balance the readout comparator circuit, the resistance in series with the shutter timing capacitor is also varied. (see illustration). The Polaroid shutter circuit, you will remember, varied the capacitance of the timing capacitor to adjust shutter speed; this is the major difference between the two circuits.

The Yashica shutter circuit is slightly more complex in that it has three transistors rather than two in its timing circuit, and has an extra switch and protective resistor which make up a special circuit for use in the "bulb" position of the shutter dial.

Its comparator circuit balances the current through the pair of CdS photocells (LDRs connected in parallel) against the current through a variable resistor which shares a common shaft with the shutter speed variable resistor.

Having two LDRs in parallel improves the accuracy of the light readout system because the current flowing through the two is averaged and each of the LDRs is positioned to "see" a different area of the picture.

The TL Electro-X is mechanically unique too, in that it has a focal plane shutter which moves vertically across the image area from top to bottom.

Because the shutter sectors travel over a shorter distance with a vertical run (by a factor of 3 to 2), the shutter can open and close faster. The shutter opens fully for any exposure under 1/125 second, as compared to 1 30 to 1/50 second for most focal plane shutters. Use of electronics for shutter timing control eliminates the need for a governor and many of the gears, springs and levers normally associated with focal plane shutters.

The principle of operation is very similar to that of the Polaroid shutter, though it is more complex. When the shutter release plate moves downward, both sectors are

We've got 'em taped, so

COUNT ON CANON

The only one that prints out,

There are a lot of small sized calculators on the market these days. All of them add, subtract and multiply. The differences are few. With one exception. **The Canon Pocketronic**. The only-one-of-its-kind pocketsized printing calculator that prints out on the world's only snap-in snap-out tape cassette. Printed proof to hold on to. Easy to store — easy to mail tape cassettes.

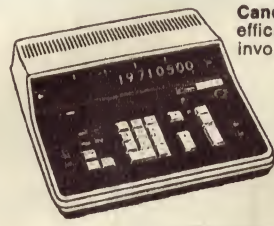
Take a look at CANON To-day and find out why so many companies COUNT ON CANON exclusively.

Canon make over 20 electronic calculators — modern offices around the world are all counting on Canon for consistently high standards of performance and reliability that result from their latest large scale integrated circuit techniques.

All the calculators listed here — from the mini-marvel Pocketronic to the programmable 164P are the result of long years of Canon research — precision in micro-electronics and optics is our business.

Canon can.

Canola L163: 16 digit, 2 memory and square root key. The statistical model.



Canola L141: Highly efficient, 14 digit, invoice calculator.

Canola L162: 16 digit, 2 memory highly versatile portable, for timber, hardware, steel calculations.

Canola L120: High performance compact calculator with constant key, reverse key, shift key. L121 with memory.

Canola 164P: 16 digit, 4 memory, 64 step programmable calculator with punch card system.

Swift & Bleakley Pty. Ltd., 149 Milton Street, Ashfield, N.S.W. 2131
Phone Sydney 798 4111, Melbourne 699 1877, Adelaide 57 9001
Brisbane 5 3726, Perth 21 5657, Canberra 95 7560, Hobart 28 3716.

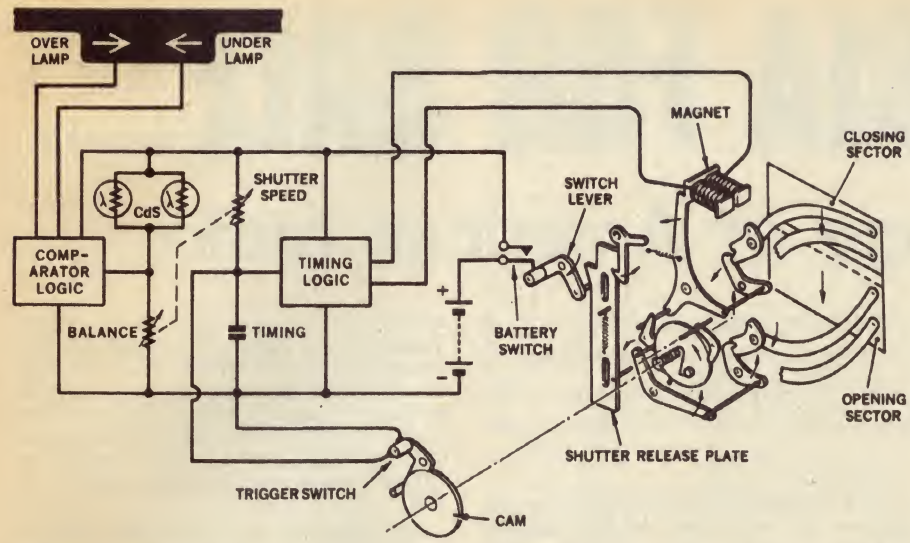
Please send me more information about the Pocketronic and Canola Range of calculators

NAME .....

ADDRESS .....

POSTCODE .....

959C



Functional diagram of Electro-X shutter shows how it is integrated with the electronic exposure readout system.

mechanically released and the bottom one is pulled downward by spring action. At the same time, the battery switch closes to energise the circuits and the trigger switch opens to permit the timing capacitor to begin charging.

At the end of the time period, governed by the setting of the shutter speed variable resistor in series with the timing capacitor, the magnet is de-energised and the top sector moves down.

The TL Electro-X also contains a third electronic circuit in the form of a one transistor battery condition checker which lights a lamp to indicate the battery level is sufficient to operate the electronics.

Readers wanting additional information about the cameras described in this article can get it by means of the Reader Information Service coupons on page 128.

Public videotelephone on trial

Is the videotelephone just around the corner? Many stories in the daily press would have us believe so. On the other hand, engineers who can appreciate the problems consider that such a service is many years away. Here is a story about the latest approach to the challenge.

There have been many demonstrations of videotelephone systems over the past few years but, with very few exceptions, they have done little to solve the basic problems of a commercial videotelephone system.

The demonstrations have invariably been over short distances, often within the same building, and via cables specially designed for the bandwidth required. Alternatively, if longer distances were involved, the circuit was between points already served by circuits having adequate bandwidth.

The real problem has always been that of transmitting video signals over ordinary telephones lines, as used between the exchange and the subscriber, and through the exchange switching networks. Designed primarily to carry audio signals requiring only a few KHz bandwidth, these lines exhibit intolerable losses at frequencies significantly beyond this bandwidth, such as would be required by TV signals.

Where the cost can be justified, the answer is to use specially designed co-axial cables which can handle the frequencies involved. However, these are expensive and, if they had to be provided for each subscriber, the cost of the service would almost certainly be prohibitive.

While no one has really solved this problem yet, an experiment currently being conducted in Germany looks like coming closer to this ideal than any described so far.

The first public videotelephone conversation between Munich and Darmstadt, West Germany, a distance of about 250 miles, was conducted some months ago by the head of the German Post Office, Mr George Leber, and Mr Dieter von Sanden, a director of Siemens.

This trial operation between the German Post Office and the Telecommunications Centre of Siemens AG is a continuation of a development which began as long ago as 1936, with the world's first public videotelephone connection between Berlin and Leipzig.

However, this was a fixed point-to-point connection. The new system has been extended into the homes of subscribers participating in the trial project. Each subscriber can dial other videotelephone subscribers directly. The field trial of the video exchanges and the video transmission link will continue for several years. The experience gained should be of great value in the planning of future videotelephone networks.

Whereas a conventional television picture is transmitted in one direction only, videotelephony requires simultaneous transmission of pictures in both directions. In areas served by local exchange networks, economic considerations rule out the use of coaxial cable for video transmission; here only ordinary cable wires can be used.

The current system has been designed to take this into account. It is a 225-line, 25-frame system, using line interlace, and produces a picture 11 x 10cm. The total bandwidth required is 1MHz.

The video signal of the videotelephone is transmitted from one terminal to the other over four wires. The speech information takes the usual 2-wire path over the subscriber line. Connection of the videotelephone therefore requires six wires. Despite the comparatively large bandwidth of 1MHz, video channels can be connected through telephone switching equipment. The ESK relay, developed by Siemens, constitutes the switching element. The video trunks are through-connected in a 4-wire switching network, which also establishes the separate speech path simultaneously.

The videotelephone exchange of the German Post Office at Darmstadt is connected to Frankfurt by means of a radio link and the connection extended via Stuttgart to the Olympic Tower in Munich over the radio relay network of the German Post Office. Calls are conducted partly over 6GHz and partly over 4GHz radio relay systems. From the Olympic Tower, connections are extended to Siemens videotelephone exchange in the south of Munich along approximately nine miles of local telephone cable with repeaters every mile or two.

The repeaters are really the secret behind ability to transmit signals of this bandwidth over ordinary telephone lines. They provide both an overall boost to the signal level and a compensating boost to those frequencies which have been more seriously attenuated.

At present there are five subscribers at the German Post Office end in Darmstadt and 10 at the Siemens end in Munich. It is proposed to extend the trial network to Bonn but the introduction in Germany of a videotelephone service for the general public is not expected before 1980.

As a result of the internal videotelephone tests which have been running since 1967, Siemens has recommended that the German Post Office should propose the following values to the CCITT, to be adopted as definitive standards:

Number of lines	267
Line frequency	8KHz
Frame frequency	30Hz
Interlaced scanning	
Video band width	1MHz
Screen size	13 x 15cm

There are good prospects that these standards will find world-wide acceptance, since other postal authorities have meanwhile made similar standardisation proposals. This indicates that developments throughout the world have led to similar results. A great deal of work is currently being carried out at Siemens on equipment conforming to these future standards.

In the devices so far installed, the image recording unit (camera) and the image reproduction unit (display unit) form a constructional entity. A vidicon tube and a picture tube are both mounted vertically. Light rays from the camera lens, and the picture tube, are passed through prisms which turn them through 90 degrees.

The telephone set associated with the videotelephone is a pushbutton set equipped for hands-free operation. A speaker mounted underneath the screen creates the impression of a "talking" picture. Subject matter such as documents and drawings placed on a table in front of the videotelephone can be transmitted with the help of a deflecting mirror. A monitor circuit enables the user to control the picture recorded by his camera. This can be disconnected during the call, so that the subscriber can decide whether or not he shows himself to the other party.

NOSTALGIA FOR SALE....

the "Goldin" age of American radio

Fred Allen, Jack Benny, The Goons and the other great radio shows of the thirties and forties have disappeared from the program schedules of American radio stations — but those with nostalgic memories can relive some of the great moments of radio's golden age through the single-handed efforts of an enthusiastic collector.

About a dozen years ago, young David Goldin was sitting in his living room watching the TV; feeling a little dissatisfied somehow that the program wasn't holding his interest.

"They aren't like the old radio programs," he said to the friend with him, "you could really let your imagination run, and the suspense was almost unbearable while they led up to the climax."

"Yes," agreed the friend, "Trouble is most of them have gone off the air."

"Too bad, too," replied Goldin, musing, "Somebody ought to try to save them."

That somebody turned out to be Dave Goldin himself.

Shortly afterwards, he began tape-recording the shows from the golden age of American radio broadcasting that were still on the air. And when the last network dramatic program, the detective show "Yours truly Johnny Dollar" went off the air on September 30, 1962, Goldin began scrounging around for the old 16-inch transcription discs — or "ET's" as they were called — on which the programs had been recorded in the days before audiotape.

He wrote to other collectors, and pestered radio stations to let him have what they still had lying around.

What began as a small collection of 500 or so discs grew into a vast library of more than ten thousand radio shows from as far back as 1922.

Collectors began coming to him; even producers of the now-popular "nostalgia" LP's. Finally, in 1967, Goldin went into business for himself, and set up **Radio Yesteryear**, a custom recording service. People could select whatever they wanted out of his ever-growing catalogue, and he would make up a duplicate tape from his library of tape masters. When cassettes and tape cartridges came on the market, he offered the same service in that medium as well.

The next year, he brought out his first record album. On the Viva label, "Themes Like Old Times." was a collection of the musical introductions of dozens of old radio shows.

The album sold well, and reached No 20 on the "Variety" list of hits, staying there for several weeks. Another album, a tribute to the comic W. C. Fields, was nominated for a "Grammy" (short for Gramophone), the American recording industry's award for excellence.

Goldin maintains that his collection is a reflection of his own personal taste. And although the humour of some of the great American radio comedians was almost legendary, Goldin says his favourite programs are the "Goon Shows" produced

David Goldin with his rack of Tapesonic tape duplicating decks (left), and with some of the records he sells to interested collectors in the USA.

by J. Wandre

Armed with magnifying glass and aerosol of furniture wax, David Goldin detects and treats flaws in an old 16in transcription disc.

and syndicated by the BBC in the 1950's, featuring the Peter Sellers / Harry Secombe / Spike Milligan team.

His library also contains many other interesting recordings: speeches by Hitler and the rest of the Nazi hierarchy; a surrender speech by Mussolini ("at least the person who gave it to me said it was Mussolini — to me it's just some guy ranting in Italian for eleven minutes.")

He has the original, undoctored version of the 1937 Hindenburg airship explosion at Lakehurst, New Jersey; the recording of an eyewitness account, and the actual sounds of a B-24 bomber slamming into the side of the Empire State Building in New York City, in 1945.

A recent acquisition Goldin treasures is a complete transcription of a 1950's baseball game between the old Brooklyn Dodgers and the former New York Giants.

But these types of programs are the exceptions, the oddities in Goldin's collection. The major portion is made up of hundreds of hours of the great comedian Fred Allen's Down In Allen's Alley, and the Jack Benny Show; situation comedies such as Ozzie and Harriet, and Amos 'n Andy; thrillers such as Suspense, and Inner Sanctum; the detective shows Mr. District Attorney, and The FBI in Peace and War. There are also scores of afternoon kiddie shows, complete with commercials and "special offers"; and dozens more of the programs that entertained Americans in the days before the boob-tube.

What sells today? "By and large, people still want the comedy shows," Goldin says. "They want to hear Jack Benny, and Fred Allen again — they want to be entertained."

Soap operas, of which Goldin has hundreds, are a comparatively poor seller, mainly because most of Radio Yesteryear's customers are men. Two recordings in the "documentary" category that do well are President Franklin D. Roosevelt's Declaration of War against the Japanese, on December 8th, 1941; and CBS News Correspondent Douglas Edwards' broadcast of the electric power failure that darkened the northeastern part of the United States for two days back in 1965, "Don't ask me why anybody wants to hear that, but they do," Goldin says with some puzzlement.

Orders come in from former radio personalities, from other collectors, and from just plain folks from all over the United States, and overseas. However, Goldin has stopped selling directly to customers outside the US. He claims that the high postal rates, the time it takes for the packages to arrive, duty, and remittances in foreign currencies are too much of a hassle. He will sell to anyone overseas who has a friend living in the United States; or to someone who has access to an American serviceman stationed overseas who would be able to use the military APO, or FPO mail service.

In 1970, Goldin began producing records under his own label, Radiola. His first album "Jest Like Old Times," a collection of one-line jokes by famous radio comics, sold out. Sales of its sequel, "Son of Jest Like Old Times," are doing well. A dozen records are to be produced for 1971; twelve more for 1972.

While it remains true that more people own record players than tape recorders, Goldin isn't eager to rush into the record producing business on a large scale.

"I am hesitant about imposing my editorial taste on my customers," he admits. "It means that they have to take what I like. And if they don't like what I like, it means I get stuck with a couple of thousand records that won't sell."

Goldin has a sixty-minute sample reel available from Radio Yesteryear, Box H, Croton-on-Hudson, New York, 10520, USA. It costs $5, half the usual charge for a custom recording of an hour's material. Goldin also records on cassettes and tape cartridges, for a basic charge of $12 per hour of recorded material, whether it is one long program, or bits and pieces selected by the customer from the catalogue.

Most of the acetate-on-metal discs are in remarkably good condition. To reduce scratch, Goldin uses a spray wax (Johnson's Pledge), and rubs it into the grooves. Deep gouges are filled in with a grease pencil. The result on the tape is a "whmmmmp" instead of a "claaaak". Some of the programs made during the war years were recorded on glass transcription discs. Repairing them for recording is a tedious job of looking through a magnifying glass to align the grooves, then using adhesive tape to hold the disc together while transferring it to tape.

For recording, Goldin uses an ancient 1947 console model turntable with two tone arms: a Gray model for lateral tracking, and an RCA-Universal tone arm for the older method of hill-and-dale tracking. The tone arms track at anywhere from 3 to 5 grams, with an unorthodox 2.5 mil stylus. Using acetate tape, he records his masters using an Ampex 601 portable recorder. Fidelity is no problem, since the ET's were required to have a frequency response of from only 100 to 5000 Hz for broadcast on AM radio. But with some experimentation on his frequency equalizer, Dave can come up with a frequency response curve that will make the old recordings sound pretty good on today's superior audio equipment.

For duplicating on reel tape, Goldin uses a Tapesonic vertically mounted deck. This machine is custom crafted by a one man company in New York City.

Unlike many promoters who have cashed in on the current wave of nostalgia in the US, by producing cheap and gimmicky imitations of the past, David Goldin remains a dedicated and active restorer of a moribund aspect of radio broadcasting. And sitting in his air-conditioned, humidity controlled recording studio, located in the basement of his spacious country home, he says sadly, "Old time radio never had to die — look at England and Australia. They are still in the business of producing and syndicating radio programs — as well as doing television. There is a whole industry still going; actors, writers, technicians still making a healthy living; and hundreds of thousands of people still tuning in every day, same time, same station."

ISOPLANAR — a new process for ICs

A new process for manufacturing bipolar integrated circuits, called Isoplanar, has been developed in the USA by Fairchild.

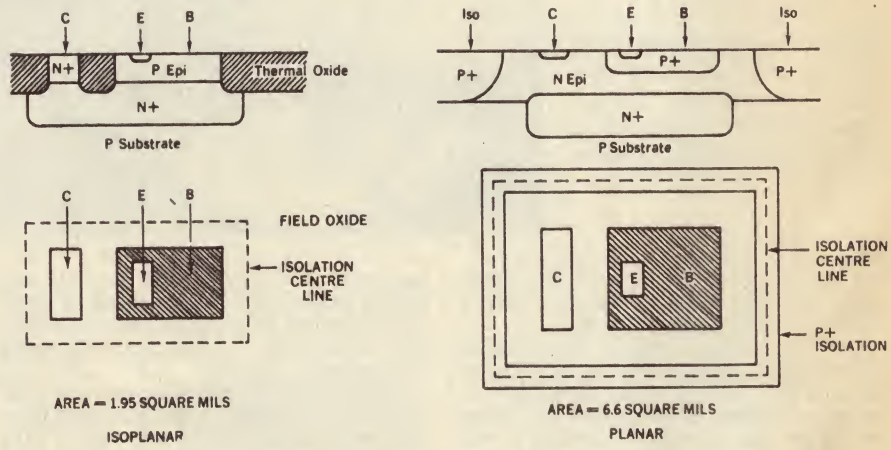
The Isoplanar process provides the ability to design integrated circuits combining the complexity of metal oxide.silicon (MOS) devices with the performance of transistor-transistor logic (TTL) and emitter coupled logic (ECL) devices. Component densities comparable with MOS are possible with higher yields than conventional bipolar devices. Other advantages claimed are high reliability, retention of the bipolar features of high speed, single power supplies, and direct logic compatibility with TTL and ECL.

Essentially an evolution of the Fairchild Planar process, Isoplanar is a new method of achieving electrical isolation between various components in an integrated circuit. The Isoplanar and Planar processes have many similarities: both use buried collectors, epitaxial layers, base diffusions, emitters and metal interconnect layers.

The Isoplanar process selectively grows a thick thermal oxide in place of the P+ isolation region of the Planar process. The oxide, an insulator, needs no separation from base and collector regions, resulting in a reduction in chip size. Other advantages offered by the Isoplanar process include increased yields due to the elimination of many isolation defect sensitivity problems, greater flexibility of interconnection, and simple masking rules. These lead to increased complexity in a given area at lower cost than conventional bipolar. The result — more functions per dollar.

The size reduction potential of Isoplanar is shown in the diagram. Two bipolar transistors are shown — one Planar — one Isoplanar. The older Planar process requires a large region for P+ isolation and isolation-to-base clearance because isolation is achieved by means of a reverse biased P-N junction. Isoplanar processing shrinks the first region, filling it with a thick insulating oxide, and eliminates the second. Assuming identical mask design tolerances, the Isoplanar transistor is about half the size of the planar device.

Tighter tolerances than are possible with conventional processing will permit even smaller geometries in the future.



Cross section and plan of Isoplanar and Planar (conventional bipolar) transistors showing the area reduction achieved.

Major features of the Isoplanar process which contribute to improved yield and lower cost per function include:

(a) Smaller devices which have a lower probability of containing a defect.

(b) Higher packing density, which means either much more complex elements than before (1K RAMs and above) or smaller (therefore lower cost) chips for the same function.

(c) Oversize masks, providing simpler mask alignment procedures.

(d) Self-aligning masks. Transistor bases, sinks and resistors are positioned with respect to each other and the isolation by the isolation mask. This means either simpler processing or the ability to achieve tighter mask design tolerances.

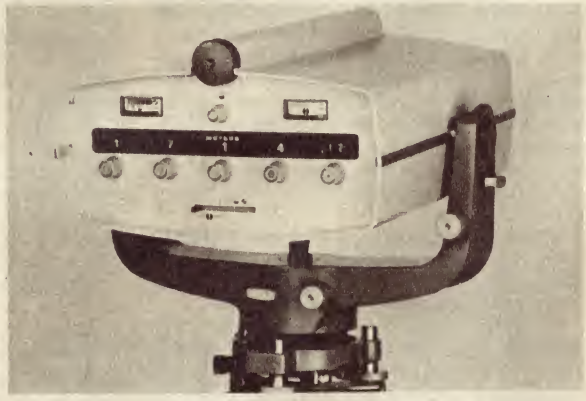
(e) Higher yields are possible because of the insensitivity to oxide pinholes caused by mask defects.

(f) The essentially coplanar surface simplifies reliable metalization and promises extremely high yield multilayer metal processes. The largest step is at the base contact which is less than 3000Å compared with up to 8000Å on conventional bipolar circuits.

(g) Speed-power performance improvements are achieved because of the reduction of transistor sidewall capacitance.

Electronic Distance Measuring Instrument

A low-cost instrument that uses an invisible beam of infrared light to accurately measure distances up to 3000 metres has been announced by Hewlett-Packard Australia. The unit is designed primarily for use in surveying and photogrammetric control. It can also be used to detect and measure sway in large structures, and for a variety of other measuring tasks.



Preliminarily aimed by a built-in 18X telescope, the instrument measures the length of time it takes a beam of infrared light to travel from the meter to a reflector and back. It converts this elapsed time into a distance measurement, which is displayed directly in metres. The method of modulating the light beam with four different frequencies eliminates any measurement errors that might be caused by the movement of heavy traffic or pedestrians through the light beam.

Controls on the instrument are marked with graphic symbols and are colour-coded to permit anyone to operate the instrument after only a few minutes' instruction.

The Distance Meter may be mounted on theodolites for simultaneous angle and distance readings for such applications as radial surveying. It can also interchange quickly and easily with existing theodolites without replumbing or recentring..

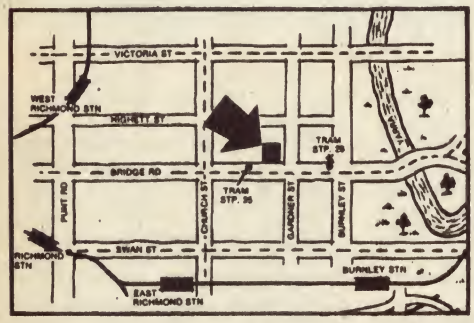
The tripod-mounted instrument weighs 7.71KG, and its separate, portable power unit weighs 5.90KG, including the battery. An internal battery charger is included, and an external battery can also be used. All electronic circuitry is solid-state, with pre-aged components. Included in the power unit is a single-dial adjustment for environmental correction.

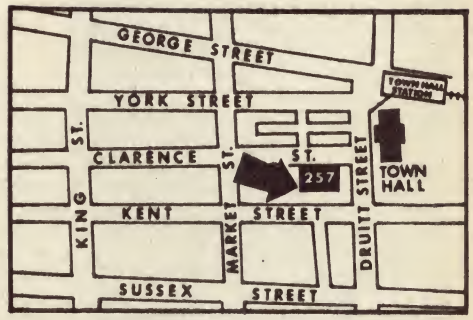
WE at Encel are using a new phrase to describe ourselves. "Australia's foremost hi-fi authorities". Presumptuous? Not a bit of it. Consider. We've been in stereo since the elementary days – 1958. We believe we were the first in the world to concentrate on high quality equipment, so we have the experience to back our phrase.

Stocks? We carry at all times, a quarter million dollars' worth of world-renowned names in the industry, in our experience and judgment, deserving of their international fame.

Our premises are designed for the business we're in with superb sound lounges for comparison of systems. Our staff is composed of stereo specialists – not salesmen. Regular overseas trips update our knowledge, widen our stocks, improve our efficiency.

Our after-sales service is unparalleled. Deal with Encel, and you're assured that, at all times, your equipment will perform to your complete satisfaction.





Our prices mean value. Because our business is stereo and only stereo, you can buy complete systems from $149.00 up, and in any price range, Encel means value.

We offer terms that bring ownership of the best equipment within reach, and we'll accept your trade-in. We also mail order equipment all over Australia. Careful packing and insurance while in transit are two Encel principles.

Among a fantastic range, we have stacks of information on Celestion KEF, Sonics, Wharfedale, SEAS, Interdyn, and Janszen speakers; Lux, Rotel, Sansui, Sony, Interdyn, J. E. Sugden, Kenwood, Cambridge amplifiers; Marlux, Revox, Akai, Sony, Tandberg tape recorders; Sansui, Connoisseur, Dual, Micro, Lesa, JH turntables; Stax, PML, Rotel, Sansui headphones; Lustre, Grace, Micro tonearms and cartridges; ADC, Grace, Ortofon. Micro and Shure cartridges, and PML Condenser Microphones. Ask and you shall receive, wherever you may be.

■ AUSTRALIA'S FOREMOST HI-FI AUTHORITIES

MELBOURNE: 431 Bridge Rd, Richmond, 3121.
Tel: 42 3762.

SYDNEY: 257 Clarence St. 2000.
Tel: 29 4563, 29 4564.

ENCEL
ELECTRONICS PTY LTD

Improving ultrasonic bonding

One of the major causes of failure in microelectronic devices is defective bonding of the package leads to the semiconductor chip. Recent research has pinpointed the reasons for some of these failures and developed a new method of calibrating ultrasonic bonding machines.

The chip of active components in a semiconductor microelectronic device is very small (typically about .010 to .400in on a side), so connecting the device to the exterior leads of the package presents a critical manufacturing problem.

Connection is made from metallised areas on the chip, called pads, to the package leads by means of .001in diameter aluminium or gold wires, which are usually attached by ultrasonic welding. A delicate and highly specialised bonding machine is used to position the end of the wire in relation to the pad and to press the tip of a bonding tool against it.

When the transducer at the end of the bonding tool is energised by ultrasonic power at a frequency of about 60KHz, the tool tip vibrates with a displacement of about 60 to 70 microinches. It is pressed against the wire first to break up the surface oxide on the metal and then to weld the wire to the pad.

Major causes of early device failure have been found to be either a lifting off of these welded contacts, or breakage of the wire at the point of contact with the weld.

A team of research scientists at the US National Bureau of Standards has recently announced the results of a two year study of the causes of defective wire bonding and has designed calibration methods for production-line bonding machines that should result in more reliable transistors, diodes and integrated circuits in the future.

A destructive pull test has been widely used in industry to determine if wires adhere well enough to the pads to withstand stipulated levels of tension. The semiconductor scientists began their study by statistically analysing the pull test to determine its usefulness, since it has long been used as a quality control procedure. However, because it is a destructive test it could only be used on a sample basis.

Pull test studies led to more knowledge of how the wire-to-pad bond is formed. The research team examined the adhesion patterns of wire bonds removed during the pull tests with the aid of a scanning electron microscope, and found that the welds tended to form in a distinct and repeatable pattern.

Photomicrographs of the pads showed that the ultrasonic bond is formed under the vibrating tool in the following sequence: First the wire is flattened, then the area under the wire is polished as a result of the wire's movement against it. Bonding begins at random localised points and then appears in additional areas, typically covering the bond heel and toe area. Then the weld spreads around the sides of the flattened wire with the centre frequently remaining unbonded, even for some very strong bonds.

One of the production line problems has been involved with how to ensure that the bonding tool tip is vibrating at its maximum for that particular installation. This had been done in the past by observing the resonant dip in the electrical current used to drive the transducer, while adjusting the level and frequency of the power applied. The researchers discovered, however, that this resonant dip does not correspond with the maximum ultrasonic motion of the tool.

They decided to use a capacitor microphone to monitor tool movement, and with the aid of an oscilloscope, were able to monitor the effects of changes in transducer power, frequency, mounting method, and in tool length and position. As a refinement

WELDING A SEMICONDUCTOR. At left, Kathryn Leedy, electronic engineer at the US National Bureau of Standards, positions a semiconductor wafer under a bonding tool for an experimental weld.

MAGNETIC PICKUP is shown at right, in position for calibrating the tip of an ultrasonic tool used to bond aluminium wire to metallised pads on a semiconductor device. Output of the pickup is watched on an oscilloscope while adjusting the transducer driver for maximum efficiency at the tool tip.

WELDED CHIP is shown at far right, after the connecting wires to the package leads have been ultrasonically bonded. The flattened areas at the ends of each wire are the bonds.

ADHESION TEST. Scanning electron microscope photo at left shows the area of good adhesion under a wire bond. Wire has been lifted off the pad by the bond-pulling machine shown below.

on the microphone method, they more recently have used magnetic sensors and have calibrated them against tool movement as measured by a laser interferometer.

The new measuring techniques have disclosed a number of uncontrolled factors in ultrasonic bonding. One example is the consequence of changing the extension of the tool below the transducer horn. The tool is mounted in a hole drilled through the horn and is clamped by a setscrew. There are critical regions of tool extension that produce undesired resonance of the tool alone. Plotting the vibration amplitude at points along the length of the tool discloses a characteristic system of standing waves, with a node midway between the peaks at the tip and at the horn. The ultrasonic vibration amplitude at the tool tip and the shape of the standing wave pattern can be altered unpredictably by a slight change in position of the tool in the horn.

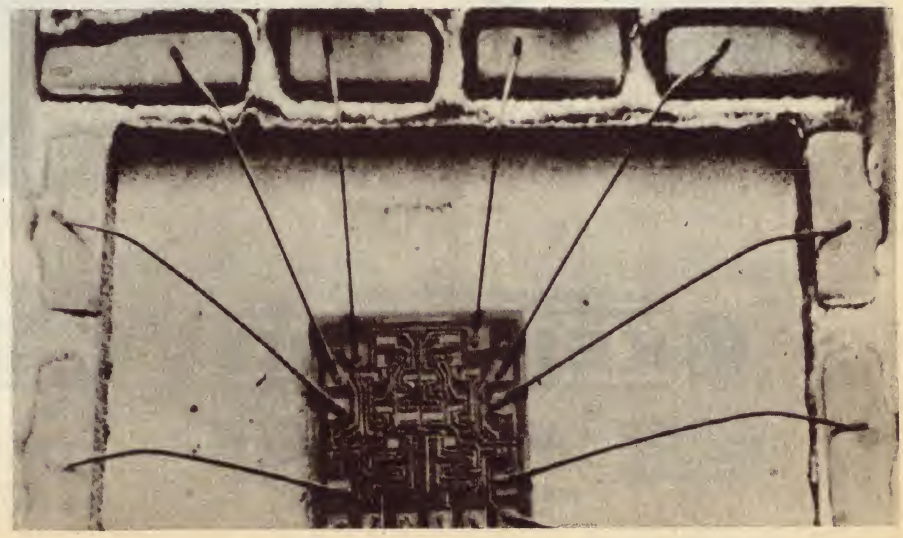
The effects of uncertainty about the horn-tool interface can be avoided by using the output of either the magnetic sensor or the capacitor microphone to adjust the ultrasonic power generator for the desired motion at the tool tip. The magnetic detector is relatively easy to use by an inexperienced operator, making it particularly useful in re-establishing the desired amplitude of tool tip vibration after any change.

One source of this unexpected variability was found when the tool was removed and replaced in the same apparent position; the standing wave pattern resulting was considerably changed from the earlier one. This difference was found to be due to variations in the seating of the tool in its hole when clamped by the setscrew.

Other uncontrolled factors which have been observed to have a significant effect on the bonding process include unwanted vibration in the system induced by the machine itself, the building, and the operator's hand. Such vibrations can cause movement of the work stage relative to the tool tip which, if it occurs during the actual bonding period, may result in a lift-off or low pull-strength bond. Special brackets increasing the rigidity of some bonding machines help reduce unwanted vibration.

It was found in a study of the temperature characteristics of the ultrasonic transducer system, that the multiple high-intensity lamps used to illuminate the work area on some machines can cause detuning as the unit warms up. To obtain reproducible bonds, heat-absorbing filters should be used in front of the lamps or the transducer should be pre-heated by turning on the lights for several hours prior to bonding.

Calibration of production line bonding machines by use of the magnetic sensor or microphone pickup, along with an oscilloscope, and the elimination of some of the other variables discovered by the NBS research team have resulted in increased yields in the American semiconductor industry.



SCIENTIFIC AND INDUSTRIAL NEWS

Fibre optics for motorway signs

A fibre optic system for motorway indicator signs has been developed in the UK by Rank Precision Instruments Ltd. Compared with existing signs, using sets of incandescent lamps, the new system cuts down by about 90% the number of lamps required, produces a brighter image and has greatly reduced power requirement.

In the existing signs, groups of lamps (each with its own parabolic reflector) are used to form letters and numerals in the legend presented by the signs, and each legend requires numerous separate lamps. In the fibre optic system, the light from a single lamp is conducted by fibre optic light guides to a group of lens cells on the face of the sign arranged to make up the pattern of the complete legend. In a conventional display, typically 139 lamps would be required. An equivalent fibre optic sign would require only 14 lamps to provide the same legends.

The new sign can be read more easily in bright sunlight and over greater distances, and sunlight does not produce phantom images on the sign which might confuse drivers. Coloured signs can be provided by introducing appropriate filters between the lamp and the ends of the light guides. (Rank Taylor Hobson Pty Ltd, 30 Hotham Parade, Artarmon, NSW 2064.)

New time scale

A new system of Co-ordinated Universal Time (UTC) commenced on January 1, 1972 at Oh UTC, ie 11am Australian Eastern Summer Time. The new time scale has the following characteristics:

Time intervals are constant and equal to one SI second.

UTC will be maintained within 0.7s of earth's positional time scale UT1 by step adjustments, when necessary, of exactly one second. These adjustments will be made by the insertion or deletion of a second, known as a leap second, at the end of a month. At the present rate of earth's rotation, a leap second will be inserted approximately once a year, making the last minute of the chosen month 61s long.

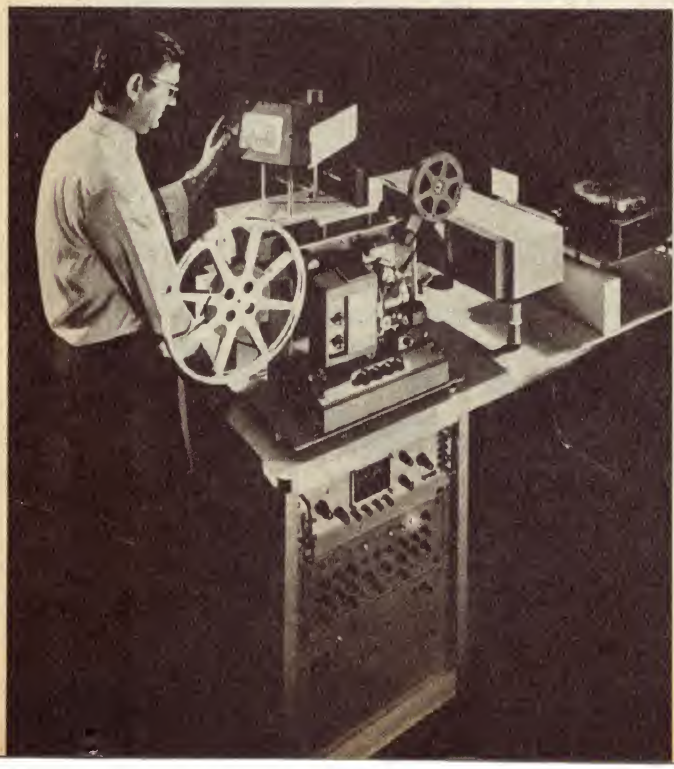
The time difference between UTC and atomic time is an integral number of SI seconds. UTC was retarded by 107.58ms at the moment of change to achieve this relationship.

DUT1 code. The CCIR has recommended that a special code be broadcast with the time signals transmitted by standard frequency and time signal stations to indicate the deviation between UT1 and the time signals. The values to be transmitted are known as DUT1 and give UT1 — UTC to the nearest 0.1s. The magnitude and sign of DUT1 is given by the number and position of a group of emphasised seconds markers emitted each minute as follows:

The magnitude of DUT1 is given by the number of consecutive emphasised seconds markers, each representing 0.1s.

The sign of DUT1 is positive (ie UT1 is advanced on UTC) when the first emphasised seconds marker of a group is seconds marker 1, the marker following the minutes marker. The sign of DUT1 is negative (UT1 retarded on UTC) when the first emphasised seconds marker is seconds marker 9. If no seconds markers are emphasised, DUT1 equals zero.

The emphasised seconds markers on Australia's VNG transmissions consist of 100ms tone bursts of two frequencies: the first 50ms is the normal 1000Hz standard tone and the last 50ms is about 900Hz tone. In order to positively identify the minute and alert the user to the following DUT1 code group, the minute marker on VNG transmissions is now 500ms long.



Moisture in leather

A new type of moisture meter for leather, developed by the leather research section of the CSIRO Division of Protein Chemistry, has been successfully tested over a two-year trial period in a Melbourne tannery. Designed for use by unskilled labour, the meter is hand operated and can be used on finshed leather or at any stage in the tanning process.

The instrument has a flat sensing head incorporating a capacitor, the fringing field of which is used to measure the dielectric constant of the material with which it is in contact. This is directly related to the moisture content of the leather. The meter has been found to be accurate over the range of moisture content of interest to tanners.

The division is now working towards a better industrial design, using the same principles but making the instrument more manageable. A new version under consideration has a sensing head with which an operator can sort through hides in a pile, taking moisture measurements at random without the necessity of moving each hide to a table. (Leather Research Section, CSIRO Division of Protein Chemistry, 343 Royal Parade, Parkville, Vic 3052.)

Educational telecine

EMI Electronics Ltd, UK, has developed a monochrome telecine for professional closed circuit television work, to meet the growing demand in university and college TV studios for a unit of this type. Previously this need has been met by ex-broadcast or home built units. Called the 416, the new unit is based on the EMI 2004 camera and accepts positive or negative 16mm film or 35mm slides. The 7in (17.8cm) viewfinder, which acts as a preview and setting up monitor, is raised above the camera and can be rotated through 360°. An automatic light control enables a wide range of film densities to be handled without readjustment of the controls. The 35mm slide projector has a detachable circular slide holder with capacity for 80 slides. The unit has provision for remote control of most functions up to a distance of 300ft (91m).

A SOUND IDEA FOR SOUND ENGINEERS!

AND COMMUNICATION & VIDEO ENGINEERS TOO!

THE BWD **506** embodies some unique features together with an excellent performance that makes it an outstanding instrument.

Its isolated ground enables 'in circuit' measurement to be made up to 400V from ground and eliminates ground loops and noise from low level measurements.

The active TV Sync. circuit provides immediate line or frame lock fast enough to see the individual frame pulses, colour bursts and equalising pulses. The circuit also provides an HF reject trigger selector and a demodulator for stable displays of amplitude modulated RF Waveforms. **• BAND WIDTH DC to 15MHz. 5mV to 20V/CM. • 40nSEC to 10SEC/CM SWEEP RANGE. • 1Hz to 15MHz AUTO TRIGGERING, BRIGHT BASE LINE AT ALL T.B. SPEEDS. • 8 x 10 CM RECTANGULAR DISPLAY. • 3KV EHT 5% CALIBRATION. • 100% SOLID STATE I.C. AMPLIFIER.**

$304
F.I.S. AUSTRALIA

WINNER OF AWARD FOR OUTSTANDING EXPORT ACHIEVEMENT

'FANTASTISCOPE'

ONLY ONE IN THE RANGE OF BWD EXPORT AWARD INSTRUMENTATION.

BWD ELECTRONICS PTY. LTD.
DESIGNERS & MANUFACTURERS OF THE FINEST ELECTRONIC INSTRUMENTATION
329-333 Burke Rd., Gardiner, Vic 3146. Ph 25 4425. 127 Blues Point Rd., Nth. Syd, N.S.W. 2060. Ph 929 7452
SOUTH AUST: A. J. Ferguson Pty. Ltd. Ph 51 6895. WEST AUST: Cairns Instrument Services. Ph 23 3871
QLD: Warburton Franki (Bris.) Pty. Ltd. Ph 51 5121. NEW ZEALAND: P. H. Rothschild, Lower Hutt. Ph 6 3581

GL&C 335BW

Very fine electroplated mesh

Dynamics Research Corporation, USA, is marketing electroformed mesh (left) for use in storage CRTs and similar applications. It is a very fine mesh allowing a high percentage of electrons to pass through. A unique single plating process yields a smooth surface wire plated to the desired transmission width. Line counts up to 2000 lines per inch with 90pc transmission are available. (Metrigraphics Division, Dynamics Research Corp, 60 Concord Street, Wilmington, Mass 01887, USA.)

Disintegrating plastics

A new process for producing plastics which disintegrate when exposed to light has been developed by the macro-molecular textiles material laboratory of the Japanese Industrial Science and Technology Agency. The process involves working in a small amount of an additive made chiefly of vinyl ketone into plastics in the course of their manufacture. This does not involve any change in the manufacturing methods, as the additive (which has the property of absorbing light and decomposing) links up with the molecules of the plastic.

In the laboratory's experiments, from 0.01 to 10% of methyl vinyl ketone (MVK) or phenyl vinyl ketone (PVK) was added to various types of polymerised plastics. It was found that when plastic containing a large amount of vinyl ketone was exposed to mercury light of 100W at a distance of 4in (10cm), it decomposed rapidly. The laboratory also discovered that the time for disintegration could be freely set by controlling the amount of the additive, and also confirmed that plastics made with such an additive were non-poisonous and could be readily used for packaging foodstuffs.

Seat belt sensor

A system which makes it impossible to start a car engine unless the driver and front seat passenger, if carried, are actually wearing a correctly fastened seat belt, has been demonstrated in the UK by the joint developers, Mullard Ltd and the Ford Motor Company.

The system has sensors in the seat upholstery which are actuated by pressure as soon as the seat is occupied, and piezoelectric generators attached to the diagonal straps of the seat belts, which transmit a fanshaped beam of ultrasonic energy to associated receivers mounted in the corners above the windscreen.

The receivers control relays which must be closed (when a seat is occupied) before the engine can be started. The relay in each circuit remains open until the receiver picks up the appropriate signal from the associated ultrasonic generator. Although the generator is activated by a switch in the belt buckle, the mere act of fastening the belt is not in itself sufficient to actuate the relay in the receiver. Unless the belt is correctly worn, the transmitter and receiver are not in alignment, so no signal is sensed by the receiver.

When the seat belt is fitted correctly, a logic unit enables the ignition switch to be operated and the car driven in the normal way. If the logic unit receives information that the seat belt is incorrectly fitted or has not been fastened, it activates an audible and visible alarm on the dashboard.

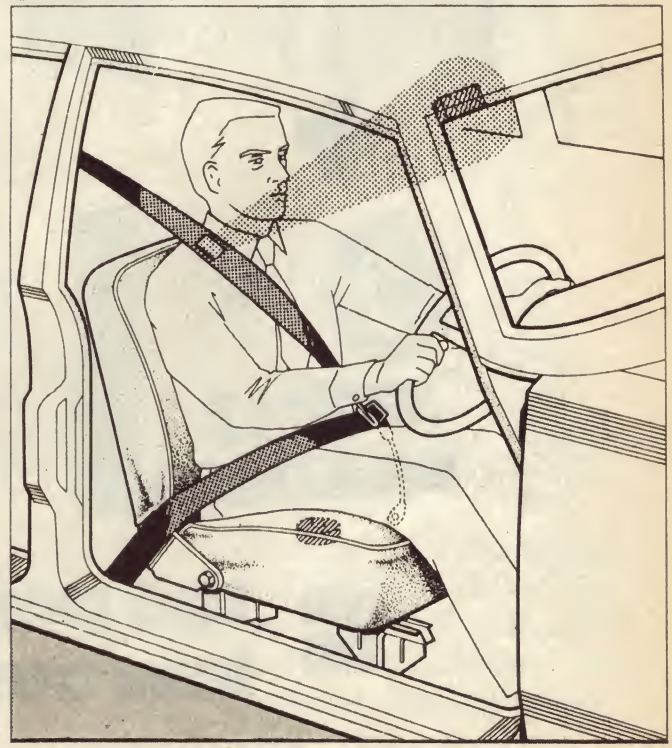
The entire system is duplicated for the front passenger seat, and if a passenger is carried the engine will not start until both driver and passenger are wearing seat belts correctly fastened and adjusted.

A number of refinements can be added. The logic unit can be arranged so that the ignition is not immediately affected if a belt is unfastened while the car is in motion. An audible and visible warning would be given but the engine would cut out only after a specified period, say 30 seconds. For parking and garaging, etc, the logic can be adjusted to allow the car to be driven in first or reverse gear for a limited time without the driver wearing his belt.

Modified STOL aircraft

A research aircraft with rotating cylinders in the leading edges of the wing flaps has been flown at NASA's Ames Research Centre in California, USA. The rotating cylinder flap system was invented by Alberto Alvarez-Calderon, a former research associate at Stanford University. It is installed on a modified OV-10A Bronco aircraft for research in STOL (Short Take-Off and Landing) aircraft. The plane also has engines with interconnected propellers so that either engine can drive both propellers.

The cylinder flaps extend across about two-thirds of the wing span of the OV-10A, and protrude slightly into the airflow over the wing. When the cylinders are rotated rapidly in the direction of airflow, the exposed surface of the cylinder induces the propeller slipstream to flow smoothly across the surfaces of the wing and deflected flap. Wind tunnel tests have shown that smoother air flow across the upper surface of the wing and deflected flap gives greatly increased lift, necessary for the low flight speeds of STOL operations.



The Mullard-Ford seat belt system fitted to a car. There is a sensor in the driver's seat (shaded) and a piezoelectric transmitter fitted to the belt diagonal. When the belt is correctly fitted, the transmitter sends an ultrasonic beam to a receiver, shown here mounted above the windscreen.

AKAI provides the answer!

New release!
AA6200 Stereo Tuner Amplifier

This magnificent all-silicon transistorised solid state FM/AM Tuner Amplifier provides 40 watts of pure, undistorted music power.

- **F.E.T. (Field Effect Transistor)** for greater sensitivity and selectivity.
- **C.F. (Ceramic Filters)** in 4 stage 1/F. Perfect reception without interference.
- **I.C. Integrated Circuits** Modular Space age Circuitry. • Low distortion factor 0.2%.
- Excellent Damping Characteristics • Power Bandwidth, 20-50,000 Hz.
- Attractive black and silver front panel • Single controls.

New release!
AKAI SW-35 Jet Stream Speakers

Dynamite comes in small packages! These "mini" sized Jet Stream Speakers produce "maxi" sound, the power and depth of which are equivalent to a large sized speaker system. To obtain a superb sound effect Akai combined an **L.T.P. (Linear Travel Piston)*** 5¼" speaker with **jet stream flow** through a unique network of passages inside the enclosure. The amazing result must be heard to be believed. Dimensions 6.8" x 17.2" x 10.8".

Akai 4000D Stereo Tape Deck

A superb Stereo Tape Deck to enable stereo fans to produce the ultimate in high fidelity recordings • Extended frequency response with exclusive 1 Micron head • All silicon transistorised preamplifier reduces noise to a minimum • 4 track stereo/monaural recording • 2 speeds • 3 heads.

= the perfectly matched low cost Hi-Fi System!

AKAI

Distributed by: AKAI AUSTRALIA PTY. LTD.
276 Castlereagh St., Sydney, N.S.W. Phone: 61-9881.
146 Burwood Rd., Hawthorn, VIC. Phone: 81-0574. And in all States.

AKO36 FP

Purifying river waters

A compact water purifying plant, which can turn the water of rivers polluted by factory waste and sewage into water suitable for drinking, has been installed in Tokyo. The plant, claimed to be first of its kind in Japan, incorporates in its compact tank the equivalent of a river's capacity to purify itself while it flows over a distance of 30 to 40km (20 to 25 miles).

Polluted river water is first guided into a biological oxidisation tank in which bacteria of scores of different species are nurtured. The dirtier the water, the larger the number of bacteria inside the tank. The bacteria eat the pollutants in the water reducing the biological oxygen demand to less than 5ppm, which is the maximum allowable standard of river water pollution in Japan. Synthetic detergents, cyanides, mercury and cadmium in the water are 90% resolved or removed. The water is then sterilised and deodorised in ozone and activated charcoal towers. It costs about 6.5c to purify one ton of polluted water with the plant.

Pollution in weather reports

We published an item in this section under the above heading in our November 1971, issue. We inadvertently omitted to say that Philips Industries Ltd supplied the sulphur dioxide detection equipment. The photograph was published by courtesy Philips Industries Ltd.

Laser microwelder

The IRD laser microwelder / driller model 3 (shown above) gives precise repeatable welds or holes with localised and rapid heat application so that processing can be carried out on or near heat sensitive materials and through glass windows or glass or clear plastic encapsulation. Extremely high temperatures, sufficient to vaporise rubies, diamonds and ceramics, can be generated in the drilling mode. The device uses a water-cooled industrial ruby laser able to operate at up to one pulse per second. (International Research and Development Co Ltd, Newcastle Upon Tyne, England NE6 2YD.)

Survey of earth's resources

A wide variety of the natural resources of earth and man's management of them will be studied by an initial group of scientists tentatively chosen by NASA to analyse data to be gathered by two earth-orbiting spacecraft, These are the first Earth Resources Technology Satellite (ERTS-A) and the manned Skylab which will carry an Earth Resources Experiment Package (EREP). The initial group of experimenters are from 28 states and the District of Columbia in the USA, and from 22 other countries including Australia.

More than 700 scientists submitted proposals for experiments with ERTS and EREP data. The proposals selected in the initial group are those on which no negotiations on the experiment plan were required with the proposer. In the case of some EREP proposals, however, some negotiations may be necessary with some proposers to determine the operation of the experiment by the Skylab astronauts. About 270 proposals have been rejected.

A general description of ERTS-A, its instruments, and Australia's proposals for the experiments were published in "Electronics Australia" in October, 1971. Briefly, the objective of the Australian proposals is to determine the ability of ERTS-type data to reveal large-scale structural and botanical properties of the terrain (in Australia, Antarctica, and Papua New Guinea), and to assess the usefulness of ERTS in monitoring changes with time in these properties of the terrain.

Included in the initial experiments proposed by US sources are plans to study the feasibility of remote sensing from satellite in gathering information on:

The effectiveness of measures to control pink bollworm infestation of cotton (California);

The colour of the ocean for the improvement of commercial fishing (Oregon);

The role of the playa lakes in the resupply of ground water in high plains (Texas);

Land use in the megalopolis extending from Boston to Washington, DC (New England);

Permafrost and wildlife habitats (Alaska);

The formation and location of icebergs (Antarctica);

Analysis of the haze over Los Angeles (California);

Preparation of hydrological atlases of arid land watersheds (Montana, Wyoming and New Mexico);

Application of imagery to fracture-related mine safety hazards (Indiana);

Investigation of severe storm environments (Worldwide);

Energy exchange at the atmosphere-soil interface (Wyoming and Colorado).

The first group of experiments proposed by scientists from other countries will study the feasibility of surveying such things as:

Land use and surface water in the savannah areas (Columbia);

Mesoscale phenomena, winter monsoon clouds and snow area (Japan);

Sea ice in the Spitzbergen area (Greenland);

Monitor vegetation growth on mine dumps (South Africa);

Detection of potential locust breeding sites (Saudi Arabia);

Cartographic research programming for small scale mapping (UK).

In addition, co-operative earth resources projects have been established with Brazil, Canada and Mexico involving aircraft as well as spacecraft remote sensing techniques.

ERTS-A is a 2100lb (950kg) satellite to be launched early in 1972 into a sun-synchronous, near polar orbit at an altitude of 565 miles (910km). Skylab is a 190,000lb (86,000kg) spacecraft which will be launched unmanned early in 1973 into a 270-mile (435km) orbit with an inclination of 50°. It will be manned later by three-man crews for one 28-day and two 56-day periods over about eight months.

Commercial broadcasting

Commercial radio station 2GO, Gosford, began transmissions on November 19, 1971, using 1310KHz. Operated by Central Coast Broadcasting Pty Ltd, the station radiates 2KW and uses a directional aerial, as it shares the frequency with 5AD, Adelaide, and 1ZH, Hamilton, New Zealand. The studios are located at Gosford, and the transmitters and aerial are at Ourimbah, about six miles to the north.

Postgraduate courses

The Division of Postgraduate Extension Studies, University of NSW, will present the following courses commencing in March, 1972.

Basic Fortran IV programming. A course 14 10 radio lectures over Radio University VL2UV, two seminars using the facilities of Television University VITU, and two discussion / tutorial sessions.

Audio equipment in communication. A course of 14 radio lectures, three TV seminars and three discussion seminars.

Video equipment in communication. A course of 14 radio lectures, three TV seminars and three discussion / tutorial seminars.

Electrical contacts. A course of 14 two-hour TV lectures with an opportunity to speak with the lecturer.

The TV seminars may be viewed at various conveniently located viewing centres in the Sydney metropolitan area. The two communication courses are also available through the division's tape correspondence service.

Full details of the courses may be obtained from the Division of Postgraduate Extension Studies, The University of New South Wales, PO Box 1, Kensington, NSW 2033.

Switchboards to Ghana

The telephone division of Philips-TMC Pty Ltd, 21 Coulson Street, Erskineville, NSW 2043, a subsidiary of Philips Industries Ltd, is to supply 113 private manual branch exchange switchboards to Ghana. The order is for the type 1500 switchboard, which uses a spring action to retract the cords horizontally in the desk-top cabinet. The Australian Post Office has 20 of these switchboards on field trials (See "Electronics Australia", June 1971, page 31.).

Chromium dioxide tape — can it provide

HI-FI SOUND FROM

Compact cassettes loaded with chromium dioxide tape are now becoming available in Australia. Used in the proper context, this new tape has definite advantages, but it is not necessarily suitable for use with all cassette recorders currently on the market, as is explained in this article.

Testing of magnetic tapes using chromium dioxide as a magnetic coating material for recording tape began in the early 1960s, but the first tapes which clearly demonstrated the important advantages of this material did not appear until around 1966.

Over the last 12 months or so, an increasing interest has been apparent among professional recording engineers, as well as high fidelity enthusiasts, in the results possible with chromium dioxide magnetic tape.

Various tape manufacturers have now developed good chromium dioxide recording tapes; also, several manufacturers of high quality cassette recorders are marketing cassette recorders optimised for the use of this recording tape; and discussions about the standards implications of chromium dioxide have begun.

CHARACTERISTIC PROPERTIES: A main characteristic of chromium dioxide (CrO_2) is that it is relatively easy to vary the coercivity over a wide range. This means that it is possible to choose the appropriate optimal coercivity for a certain application. Also, in production it is not difficult to maintain this chosen coercivity.

In addition, the form of the single particles approaches more or less an ideal needle shape so that an extremely good homogeneity can be obtained (figures 1 and 2).

Both properties result in a remarkable improvement in short wavelength recordability; the short wavelength maximum output level (MOL) as well as the short wavelength sensitivity are much better than those known from conventional magnetic tapes.

Figure 3 shows the maximum obtainable saturation output as a function of wavelength, without HF bias, of a chromium dioxide cassette tape with a 4u thick magnetic coating, compared to that of a modern "conventional" BASF LH cassette tape, having the same coating thickness.

For simplicity, the saturation output of the BASF LH tape is assumed to be flat (zero).

This kind of comparison has to be interpreted with some care, as the saturation output levels are determined without HF bias. Nevertheless, this presentation shows clearly the differences and advantages of chromium dioxide tapes, compared with conventional tapes.

ADVANTAGES IN COMPACT CASSETTES: The very high maximum output at short wavelengths is of decisive importance for quality recording at very low tape speeds; for example the compact cassette tape speed of 1⅞ips (4.75cm / S).

Those who have tried to make a good recording on cassettes from a good master or a good FM broadcast know that the major limitations of the compact cassette system are (a) high level of background noise and (b) critical high frequency recording (lack of brilliance). Cassettes usually sound rather dull, for this reason.

Figures 1 and 2. Photomicrographs of chromium dioxide tape (left) and conventional tape.

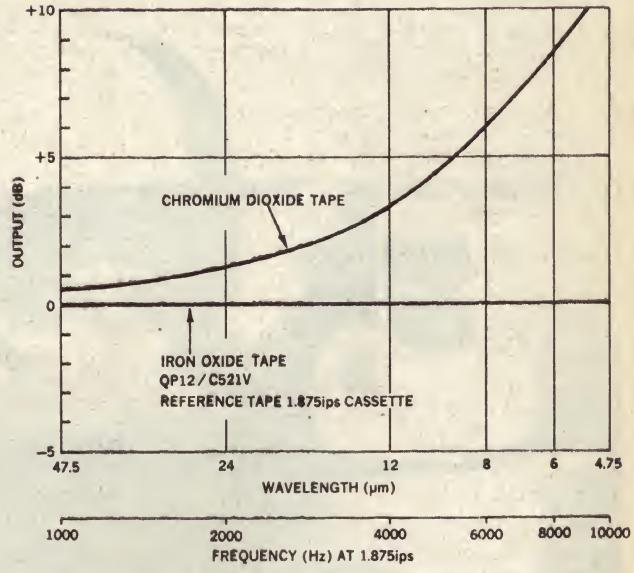
CASSETTES ?

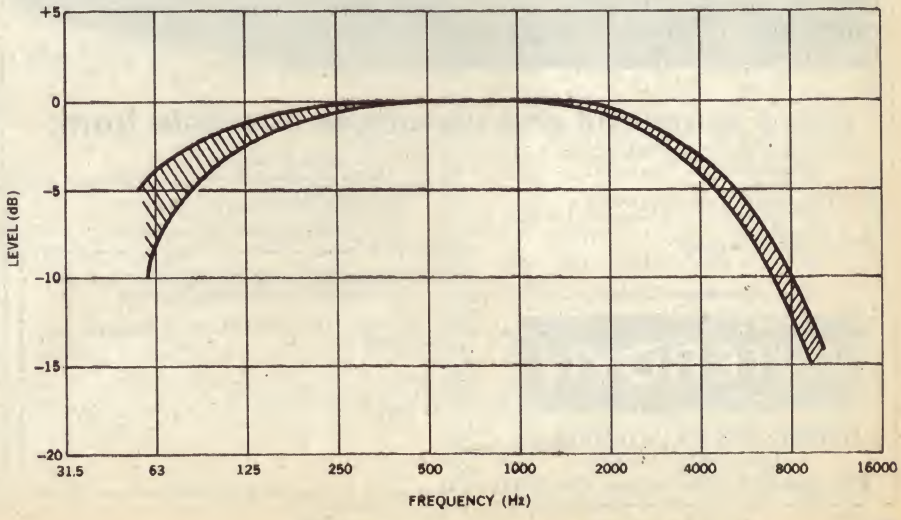
by W. H. Andriessen

ABOVE: BASF chromium dioxide tape cassettes now available in Australia.

RIGHT: Figure 3. Graphs of maximum high frequency saturation output of chromium dioxide and iron oxide tape.

BELOW: Figure 4. Maximum output level necessary for high fidelity reproduction of music.





To understand this, look at the curves given in figures 4, 5 and 6, and study their interdependence. Figure 4 shows the maximum output level (MOL) as a function of frequency necessary to obtain high fidelity on a recording medium. This curve follows as a result of various analyses of the spectral amplitude distribution in different kinds of music; it is one of the primary criteria for high fidelity.

This maximum output level (MOL) as a function of frequency has nothing at all to do with the frequency response curve, which is normally given at low recording levels (far below maximum output level) and is a measure for the transducing linearity of the recording system only. The MOL curve as a function of frequency gives the tape output at either constant distortion, constant intermodulation distortion or constant compression from linearity of the signal (eg, 5 per cent THD, or 1.5dB compression).

If the recorded signal exceeds this MOL limit, unacceptable distortion, intermodulation distortion or compression results.

The frequency response curve of the recording system (recorder plus tape) measured at a level far below MOL might be flat, because it is established by the recorder adjustment only. (Use of a reference medium such as the unrecorded portion of a DIN test tape 4.75 is assumed.)

For simplicity, it is usual in the audio tape measuring technique to choose two frequencies. The first represents the low part of the sound frequency spectrum, and the second frequency represents the high part. At 1⅞ips it is convenient to use 333Hz and 8000Hz.

On this basis, it can be said that, for adequate fidelity, it is a basic requirement that the MOL at 8000Hz shall not be more than 10-12dB down on the MOL at 333Hz. This is very much a compromise when one considers that with professional recording techniques the difference between the high frequency MOL and the low frequency MOL is normally not more than 2dB. Figures 5 and 6 show the measured MOL curves at 333Hz and 8000Hz for chromium dioxide and conventional tapes.

If the high fidelity criterion as mentioned before is applied, the HF bias adjustment

for the "conventional" tape would be so low that the low frequency MOL would be very poor, resulting in a poor signal to noise ratio. Also the drop out sensitivity at low HF bias adjustment increases. All this implies that, although from a theoretical point of view the hifi MOL difference between 8000Hz and 333Hz can be reached with conventional tapes, the required HF bias adjustment would mean a critical recording technique. In practice, most cassette recorder manufacturers use nearly all available low frequency MOL of the tape. This necessitates a relatively high HF bias setting, to obtain good signal to noise.

The loss in high frequency sensitivity is compensated in such cases by means of very strong pre-emphasis in the recording amplifier (very often more than 14dB at 10KHz) which gives a flat frequency response at very low recording levels. The loss in high frequency maximum output level (MOL) cannot be compensated, and high frequency intermodulation distortion or compression is avoided by connecting the VU meter (output meter) behind the pre-emphasis in the recording amplifier circuit.

This practice safeguards the user against high frequency distortion, since it is the high frequencies in the music which establish the VU meter indication, not the low frequency content. This means that such music is recorded at lower level.

While on paper this practice seems satisfactory, in cases of extremely strong pre-emphasis (over 14dB at 10KHz) the actual recording level will be mainly determined by the treble content of the music, giving rise to a significant discrepancy between the signal to noise ratio at measurements relative to MOL at 333Hz and that obtained when music is recorded.

Also, one should recognise that too much pre-emphasis does not help hifi, because the required LC active filters to obtain pre-emphasis cause serious oscillations, resulting in square-waveform distortion.

Figure 6 shows the same MOL curves as a function of HF bias for chromium dioxide tape. The situation is much better here because the chromium dioxide tape allows a good balance between high and low frequency MOL. A 10 to 12dB difference is obtained at a HF bias setting which guarantees a good utilisation of the tape properties from an engineering viewpoint.

Since chromium dioxide is a low-noise oxide, a remarkable improvement in high frequency output (MOL) is available at the same background noise level as that obtained from modern "conventional" tapes. Also, the signal to noise ratio improves, because the MOL as 333Hz can be used more effectively. This gives the chromium dioxide cassettes their superiority in dynamic range and other advantages. It can be claimed that chromium dioxide tapes produce at 1⅞ips tape speed a sound quality comparable to that obtained from conventional tapes at 3¾ips.

Because of the high frequency sensitivity of the chromium dioxide tape, there will also be an improvement in square-wave performance of a cassette recorder, because the advantages mentioned above can be obtained at a much lower pre-emphasis.

All considerations made so far have been based on the assumption that the replay part of the cassette recorder will not be changed. In practice however, it is expected that cassette recorder manufacturers will use at least a part of the high frequency MOL advantages of the chromium dioxide tapes to improve the signal to noise ratio of the recorders.

The key to this is to be found in the replay frequency response time constant. (In engineering parlance, it is common practice to define the frequency response characteristics of a circuit by the time constant of the relevant RC networks. Edit.). This has been standardised internationally at 120uS, but if it could be reduced to a lower value, the background noise would be reduced proportionally. However, this can be done only at the cost of the loss of a part of the high frequency output, with adverse effects on the MOL curves.

Plainly an improvement in the signal-to-noise ratio of cassette recorders is very desirable, but the question remains: Where does the economic optimum lie?

An additional complication is that some cassette recorder manufacturers have solved the noise problem by means of an electronic noise suppression system. A very good and well known example is the DOLBY B system, by means of which the signal to noise ratio of cassette recording systems can be improved up to 9dB.

It would probably be ideal if the noise problem with compact cassette recorders could be solved by means of one or another of the electronic noise suppression systems, so that the advantages of chromium dioxide tapes could be fully used to improve the brilliance.

CrO2 OPTIMISED AND OTHER RECORDERS: As CrO2 cassette tape has a significantly higher coercivity than conventional cassette tape, it is necessary to increase the bias level when this type of tape is used (figures 4 and 5). Similarly, a stronger erase signal is essential.

Less pre-emphasis is also required, although if the replay time constant is changed, it may not be necessary to change the pre-emphasis. Any such modifications will depend on the adjustment of particular recorders, which vary greatly between various makes.

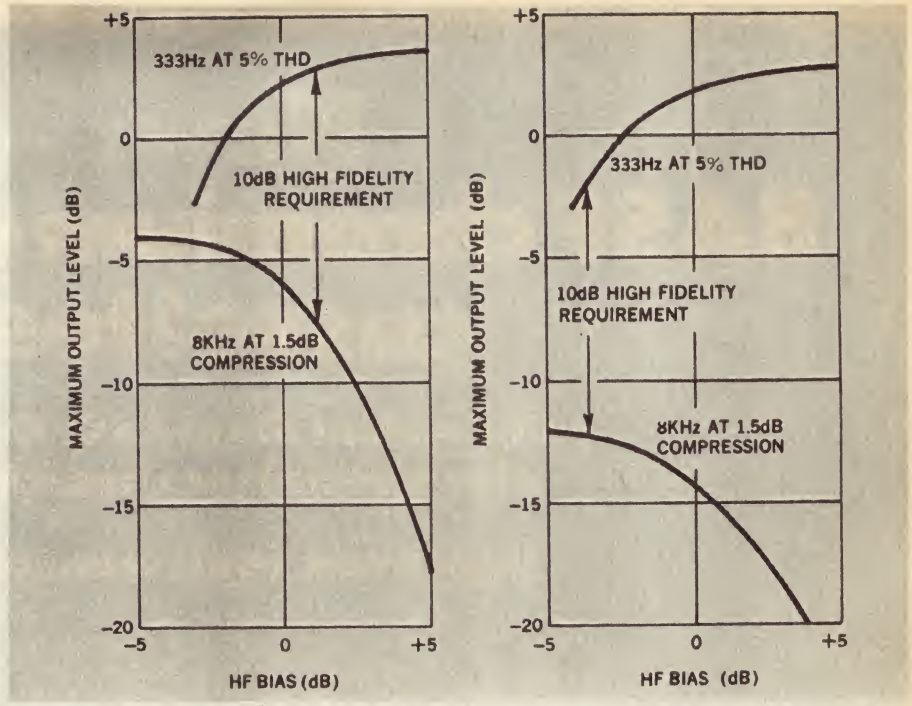
However, some data can be given of measuring results obtained when using the DIN HF bias adjustment method. This method specifies 2.5dB fall off in sensitivity from maximum sensitivity at 6300Hz.

With the chromium dioxide tapes this bias setting method results in a 2 to 2.5dB HF bias current increase relative to the bias of the conventional tape. The LF sensitivity at 333Hz of the new tape is about 2dB lower, which means that the recorders have to compensate for this to make sure that the recording level meter reading corresponds with the available MOL of the tape at this frequency.

The relative sensitivity at 8000Hz is about 6dB higher, so the pre-emphasis at the same frequency can be reduced by the same amount.

The level of the erase signal has to be increased by about 40 per cent.

Clearly, then, chromium dioxide tapes are not fully compatible with modern conventional tapes, and the cassette recorders will completely exploit the advantages of the new tape only if some of the recorder functions are modified accordingly. Possibly chromium dioxide cassettes will automatically control the necessary switches of recorders equipped to use them; for instance, by means of a device similar to that now used to prevent accidental erasure of pre-recorded cassettes.



Figures 5 and 6. MOL curves as a function of bias, at 333Hz and 8000Hz, for chromium dioxide tape (left) and conventional iron oxide tape.

CrO2 CASSETTES ON NORMAL RECORDERS: Here the situation is rather more complicated, and we shall distinguish between replay, recording and erasure requirements.

Replay. No special difficulties arise if the different properties of CrO2 tape are taken care of in the duplicating process. When a modified time constant has been used in the replay circuitry of a cassette recorder (or reproducer), and assuming that manufacturers of prerecorded cassettes have adopted the same figure, the reproduction of such cassettes on conventional cassette recorders will give an increased high frequency output and possibly even an over-emphasis of high frequencies. This can easily be compensated by treble or tone control in the playback system, and the final result will be an improvement in signal to noise ratio.

Recording: Theoretically, the different recording properties of chromium oxide tape should cause problems during recording. However, as already pointed out, many recorders have a setting of bias level quite suitable for chromium dioxide tape. A bias setting which gives maximum output at low frequencies for conventional tapes is more or less the optimum bias for recording on chromium dioxide tape (see the MOL curves as a function of HF bias, figures 5 and 6).

In most cases, it will not be the bias setting which causes incorrect recording, but the relatively strong pre-emphasis in the recording amplifier, resulting in an

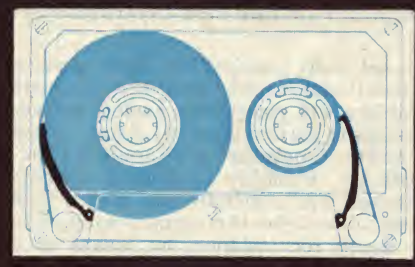
New: BASF chromium dioxide cassettes

Chromium dioxide CrO_2 plus special mechanics

Special Mechanics SM Special Mechanics

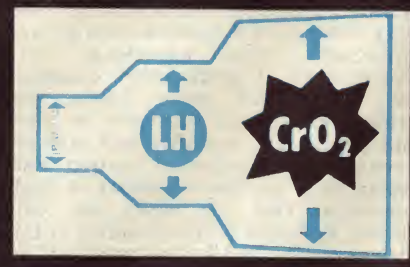
Improved tape transport

In a unique manner, BASF chromium dioxide cassettes correct certain deficiencies in conventional cassette transport systems. The new S. M. systems prevents the tape from sticking. Preclude wow and flutter. Insures trouble free running, even for extended – play cassettes.



astonishing new sound

Chromium dioxide is a quite different coating. Its extended dynamic range of the high end of the audible scale, plus the added feature of minimal head wear are qualities which you can appreciate while making your first challenging recording. Top results which show a much increased high frequency response – are best achieved on tape decks with a CrO_2 switch.



Australian Distributors:
Maurice Chapman & Company Pty. Ltd.,
276 Castlereagh St., Sydney.
Phone: 61 9881
146 Burwood Rd., Hawthorn, Vic.
Phone: 81 0574

BASF. First in tape

BASF Compact Cassettes in chromium dioxide and LH quality

over-emphasis of the high frequency spectrum. The overall frequency response will rise strongly on many recorders. However, during reproduction on good equipment this can be compensated just as simply as in the case of musicassettes, prepared for modified replay characteristics, by means of the treble or tone control.

Erasure: The erasure of chromium dioxide tapes on conventional cassette recorders remains the only real problem.

The erasability is directly proportional to the coercivity of the tape (chromium dioxide compared with "conventional" BASF LH cassette tape: about +40 per cent).

The erasure capacity varies widely between different cassette recorders. In extreme cases, the erasure capacity is scarcely enough for conventional tapes — less than 50dB. Even with machines of the same type there are big differences. However, in tests in the BASF laboratories, most of the recorders tested had enough capacity to erase the chromium dioxide tapes at standard working voltage. This presupposes fresh batteries in the case of battery operated machines.

This is logical, because battery operated cassette recorders in particular need some overcapacity in erasure potential to compensate for the decrease in voltage over the life of the batteries.

Nevertheless, with some of the recorders tested the erasure of chromium dioxide tapes was insufficient, varying from 48dB down to as low as 20dB.

DIN SPECIFICATION: The existing DIN specification for tape recorders (DIN 45500) is again under discussion. It is expected that the new standard will require (among other things not discussed here) a signal-to-noise ratio of 47dB at 3 per cent total harmonic distortion (THD) for a 333Hz signal. This requirement is about equivalent to 50dB at 5 per cent THD, which is the present tape measurement criterion.

On compact cassette equipment, mono tracks are 1.5mm wide, and stereo tracks 0.6mm wide with an 0.3mm separation track. The DIN requirement has thus to be met with a total width of 1.2mm of track. When tested with 1.5mm trackwidth, the chromium dioxide tape produces at least 53dB S/N ratio at 5 per cent THD, which means approximately 52dB at 1.2mm trackwidth.

Thus in principle it should be possible to realise DIN requirements; however there is very little room for recorder electronic tolerances under these circumstances. Therefore it is understandable that, if no electronic noise suppression is applied, a part of the excellent high frequency properties of the chromium dioxide tape will be used to improve the noise. A replay characteristic modification from 120uS to 70uS is under discussion which will bring a noise improvement of about 3dB.

In a way, the DIN requirements are a bit dangerous for tape recording because they make no requirement for maximum output level at high frequencies, which is of basic importance for high fidelity.

ELECTRONIC NOISE SUPPRESSION: On recorders with an effective electronic noise suppression (mostly the more expensive recorders) the noise problem has already been solved, e.g. recorders having the Dolby B noise suppression system easily reach about 57dB S/N (which is much better than the DIN requirement).

On such recorders the chromium dioxide cassettes are an ideal complement, because there is no need at all to give some of the high frequency advantages away in order to improve signal to noise; the tape will show its full brightness and brilliance in loud music passages with a lot of treble. It is even expected that, on such recorders, disc quality can be reached, if not surpassed, because the tape will not show the usual end groove distortion, or record clicks and other surface noises.

REEL TO REEL RECORDERS: Figure 3 shows that the main advantages of chromium dioxide tape are realised at short and very short wavelengths. This is why its use is advantageous for the low operating speeds of cassette recorders.

Most reel to reel recorders are designed to produce good sound quality at higher tape speeds eg, 7½ and 3¾ips (19cm / s and 9.5cm/s). At 7½ips the shortest wavelength which will be recorded from a good FM broadcast is about 15u. At this wavelength the difference between chromium dioxide tape and modern tape, such as the BASF LH tape, is negligible. Even at 3¾ips the advantage is still relatively small, especially taking into account the recorder adjustment switching which is necessary to use this advantage; and the higher costs of chromium dioxide tapes.

Only in the professional recording studio, where it is possible to set optimum working conditions, will it be advantageous to use chromium dioxide tape at 3¾ips. However, domestic reel-to-reel recorders could possibly use 1-7 8ips as a speed for high quality reproduction, using chromium dioxide tape.

CrO2 TAPE IN MUSICASSETTES: There are no technical objections at all to the use of chromium dioxide tape for musicassettes. All differences in recording properties can be easily taken care of during the duplicating process. It is also easy for musicassette manufacturers to follow any eventual change in replay characteristics of cassette equipment.

Musicassettes with chromium dioxide tape will give an immediate improvement in quality, at least in brilliance; and because a higher recording level is possible, also in dynamic range. On "Dolbyised" musicassettes, chromium dioxide will be a worthwhile complement.

SUMMARY: Chromium dioxide tape has an important part to play in the desired improvement of sound quality from the compact cassette system. On recorders with optimised adjustments, high quality sound to DIN specifications can be achieved. With most conventional cassette recorders a significant increase in level as well as in quality of sound is noticeable, although there may be some erasure problems. Pre-recorded musicassettes will show an immediate improvement in brilliance and dynamic range if chromium dioxide tape is used. Chromium dioxide tape used on recorders equipped with electronic noise suppression makes an ideal combination, as music with loud passages and high treble content can be reproduced with high quality and brilliance.

By George Hughes

A simple-to-build amplifier based on an integrated circuit is the key component for setting up a

LOW-COST STEREO SYSTEM

This up-dated version of our Playmaster 129 microcircuit stereo amplifier will appeal to the budget conscious reader. Distortion is around 0.5% at full power.

Stereo amplifiers published in "Electronics Australia" have varied from advanced designs capable of a high order of performance to modest low-power "medium-fi" units, designed to meet the requirements of the constructor working to a tight budget.

These simpler units have proved very popular in the past. They provide the beginner or handyman, having little previous experience, with the opportunity to build a worthwhile project, with excellent prospects of success and at modest cost. And, of course, there is the case of the parent who recognises his offsprings' claim to a record player but who does not want them to use (or abuse) his own expensive equipment.

In all such cases, the need is not simply for an amplifier. It involves the setting up of a complete system, with turntable unit and loudspeakers. Therefore, although this article is based mainly on a low cost 3.0-watt amplifier, it will also deal with the ancillary items.

The amplifier is essentially an up-dated version of our Playmaster 129 Microcircuit stereo amplifier originally described in the October, 1970 issue. This was based on two Plessey SL403A integrated circuits and, although designed along economy lines, was capable of providing very acceptable sound.

Why, then, the need for another design? The reason is simple. Since the Playmaster 129 circuit was published, Plessey engineers have redesigned the SL403A IC (integrated circuit) and have produced the SL403D. Among the advantages of this newer IC are the provision of overvoltage and short-circuit protection. Since these are provided inside the IC, they do not add materially to cost. Futhermore, since the power supply does not need to be regulated, savings can be effected in this area.

Overvoltage protection is achieved by an internal sensing circuit which is designed to switch off the power amplifier section should the supply rail exceed a certain voltage.

Again, if the loudspeaker leads or the amplifier output terminals are accidentally shorted, the increase in current flow in the output stage is sensed by an inbuilt current monitor. This has an associated thyristor which will switch off the output stage via a pair of transistors forming part of the bias and driver networks.

The output stage will be kept in this off state while there is sufficient voltage available from the power supply to maintain SCR conduction. It can only be reset by switching off the power supply itself for sufficient time to allow the power supply capacitors to discharge. If the short is still present, the SCR will fire again when power is applied. This is a similar method of protection to that used in some of our higher powered amplifiers.

The new amplifier is based substantially on information published in the UK by Plessey in their application bulletin PS1294. The wiring board which we used is similar to the original Plessey design but with slight modifications by Plessey Australia and by our own draftsmen to adapt the design to Australian components and conditions.

We would strongly advise that this board be used and the layout followed in detail. In common with many integrated circuits intended for audio work, the SL403D has a frequency response extending far above the audio range and instability can occur if the associated wiring is not suitably arranged and bypass capacitors and "stopper" resistors suitably placed.

Boards will be available through trade houses carrying either our own coding EA 71/sa12 or whatever coding is adopted by Plessey for the board which they also plan to market through parts distributors.

The SL405D IC contains all the components for the preamplifier and power amplifier stages of a single audio channel, so that two are required for a stereo system. The constructor has only to add the control and feedback components and provide a suitable power supply.

We will not attempt to describe the internal circuitry of the IC. As far as the constructor is concerned it may be treated as a component, requiring only to be soldered to the printed board.

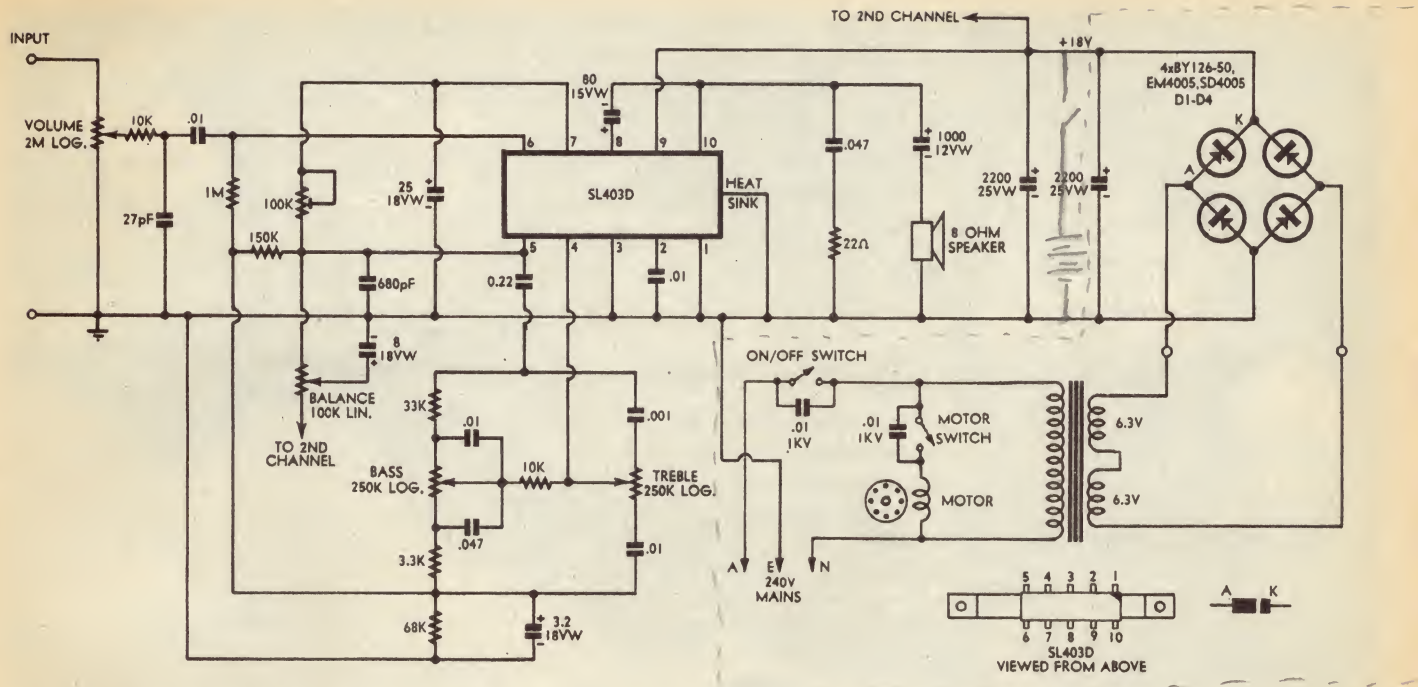
A word of warning, however. Soldering of components containing transistor elements needs care, and inexperienced constructors should be careful to avoid damaging the IC through the application of too much heat either from an unsuitable iron or prolonged application.

Most of the components are contained on the printed board, which measures 5½in x 6½in (approx 14cm x 16.5cm). The bass, treble, balance and volume control pots are carried on a metal L-bracket 5½in long x 1¾in deep (14cm x 4.5cm). It has a ⅜in (9mm) turn-up along one edge, allowing the bracket to be attached to the board by means of self-tapping screws or small nuts and bolts.

The layout of all components on the printed board is clearly shown in the accompanying diagram. Apart from the ICs, which should be mounted last of all, the components need not be mounted in any set order.

Commence assembly with all the small components such as resistors and small tubular and disc capacitors. The larger tubular capacitors should have additional anchorage (apart from the connecting leads) in the form of a thin strip of contact adhesive between their bodies and the board.

In its original design, the printed board could accommodate only one type of trimming potentiometer, the horizontal type as



The simplicity of the design can be seen in the circuit diagram. Note the correct orientation of the SL403D integrated circuit on the board.

used in our prototype and therefore shown in our photographs and layout diagrams. (Plessey type MP/PC Dealer.)

We have, however, modified the board slightly by the addition of extra holes and copper pattern, so that alternative — and cheaper— types may be used. These alternatives will be edgewise types, with 0.2in (5.1mm) pitch between pins, and they will sit diagonally on the board.

The three ganged potentiometers we used for volume, treble and bass controls are local Plessey types. Imported types are fitted with long-life moulded carbon tracks. We understand from Plessey that these should be readily available, and at a cost only slightly higher than other types on the market.

Before mounting the ICs on the board, equip each of them with suitable heatsinks — either two 2¼in (7cm) pieces of shower screen extrusion, or of 18-gauge aluminium bent to the dimensions shown. These heatsinks could be painted black, but this is not essential. (Note that the IC's should *never* be operated without the heatsinks fitted.)

Under the head of the heatsink fixing screw adjacent to pin 1 on each IC, place a small solder lug. To each of these lugs, solder a 1½in (4cm) length of hookup or tinned copper wire for connection to the "earthy" foil on the board. (Pin 1 of the IC is coded with a small spot of paint on the corner nearest to it.) Orientate each IC correctly, and solder it into place.

When all components have been placed into position and soldered, double-check the board against the circuit and layout diagrams for possible errors. If everything is in order, preparation may now be made to mount the board in its permanent position in the turntable or changer stand.

The type of record player and base will be discussed later. We will simply assume here that a suitable player has been selected.

The amplifier, with its associated power supply is compact enough to be accommodated in the the type of wooden base normally used to mount turntable decks. It is, of course, possible to mount the system into a more elaborate style of cabinet, but we visualise the system as an economy one, with expense kept to a minimum. Even so, an economy system can look quite attractive.

Mounting the amplifier unit inside the turntable base may call for some improvisation, according to the type of base used. One approach is shown in the photograph of the underside of our sample unit. The amplifier is supported at one end by the spindles of the control pots, where they pass through the front of the base, and at the other end by a piece of batten running right across the base, to which the board is fixed by two countersunk machine screws and nuts.

If space underneath the base is tight, care will have to be exercised to ensure that the control potentiometers and mounting bracket do not foul any part of the working mechanism of the turntable. Therefore, before drilling the front panel of the base for the spindles of the pots, check carefully for clearances.

The power transformer may also be mounted into position, as remote from the printed board as is feasible. Mount a 4-position connecting block close to the transformer and wire the mains voltage connections as shown in the accompanying diagram. Note that in our prototype, the mains on/off switch is mounted of the back of the balance control. The mains wiring can be run in well-insulated hook-up wire twisted together, or in figure-8 lighting flex.

The power transformer must be capable of delivering 12.6V at 1A or more. Such a transformer may be available from the junk box, but make sure the leads and insulation are in good shape. In the prototype, we used a filament transformer with two 6.3V windings which were connected in series to deliver 12.6V. Coding sheets, which usually

PARTS LIST

2 Plessey SL403D integrated circuits.
1 Power transformer 240V prim, 6.3V + 6.3V at 1.1A. (Ferguson PF1728, A&R PT2150 Jackson JA2207).
2 Loudspeaker plugs and sockets with polarised pins.
1 Circuit board 71tsa5.
4 BY126-50, 1N4005 or similar silicon diodes.
1 Suitable heatsinks (see text).
1 Control mounting bracket.
1 100K 1in potentiometer with pull-push switch.
2 250K log potentiometers (stereo).
1 2 Meg log potentiometer (stereo).
2 100K preset potentiometers. (See text).
4 Suitable knobs.
2 5-lug tagstrips.

RESISTORS: (½ watt 10%).
2 1 Meg
2 150K
2 68K
2 33K
4 10K
2 22 ohm

2 x 100k
2 x 150k
1 x 50k

CAPACITORS:
2 2200uF 25VW
1 1000uF 12VW
2 25uF 18VW
1 80uF 15VW
1 8uF 18VW
1 3.2uF 18VW
3 0.22uF 100V
2 0.047uF ceramic disc.
6 0.01uF ceramic disc.
2 0.01uF 1KV ceramic disc (see text).
1 0.001uF ceramic disc.
1 680pF polystyrene.
1 27pF ceramic disc.

MISCELLANEOUS:
Record player or changer with suitable cartridge (see text), player stand to suit, loudspeaker enclosures or kits with suitable loudspeakers, loudspeaker lead, 3-core power flex and plug, hookup wire, screws, nuts, washers etc.
Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

Proven reliability/long term stability/long life and guaranteed quality appearance... characteristics that ensure

PLESSEY RESIN DIPPED TANTALUM CAPACITORS

provide lasting service of the highest professional standard.

Plessey Series 54 tantalums are particularly suitable for printed circuit board design application in both professional and domestic electronic equipment. Conventional solid tantalum technology is employed in their manufacture, with tantalum oxide dielectric and sintered anode construction. They are available in four different case sizes.

Temperature Range Continuous operation at rated voltage from −55°C to +85°C

Rated Voltage 3, 6.3, 10, 16, 25 and 35

Capacitance Range 0.1uF to 100uF

Capacitance Tolerance ±20%

Humidity Grade H5 as specified in DEF5011

Power Factor 0.2 maximum at 120 Hz

Leakage Current 0.05uA/uFV or 2uA, whichever is greater

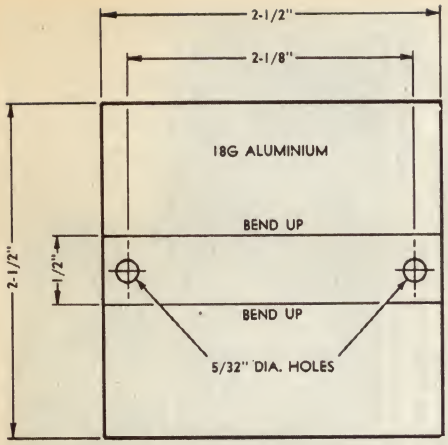
Descriptive literature is available on request to the Professional Components Department.

PLESSEY

Ducon

P.O. Box 2 Villawood N.S.W. 2163. 720133
Melbourne 42 3921 Brisbane 21 7444
Adelaide 76 3434 Perth 21 4821
Auckland (N.Z.) 78 509

AD31



This diagram shows how to construct the heatsinks required for the two integrated circuits.

accompany new transformers, will probably indicate series connection. Correct connection is indicated by 12.6V across the two windings — incorrect connection by zero volts across the the two windings. Reverse the connections of one in the latter case.

Switching clicks are minimised by connecting a 0.01uF 1KV disc ceramic capacitor across the on/off and player switches. The positions of these capacitors are indicated in the power layout diagram. Only one capacitor will be required if your player or changer is not equipped with an on/off switch.

Referring to the amplifier layout drawing and the power wiring diagram, place a solder lug under one control bracket mounting screw and solder a piece of hookup wire to this. Run the wire to the grounding lug screwed to the player chassis and solder to this, allowing a reasonable amount of slack.

The secondary leads of the power transformer, suitably connected in series to produce 12.6V, should be terminated in a tagstrip at the side of the transformer remote from the mains wiring. Extend the 12.6V connections to the appropriate points on the circuit board.

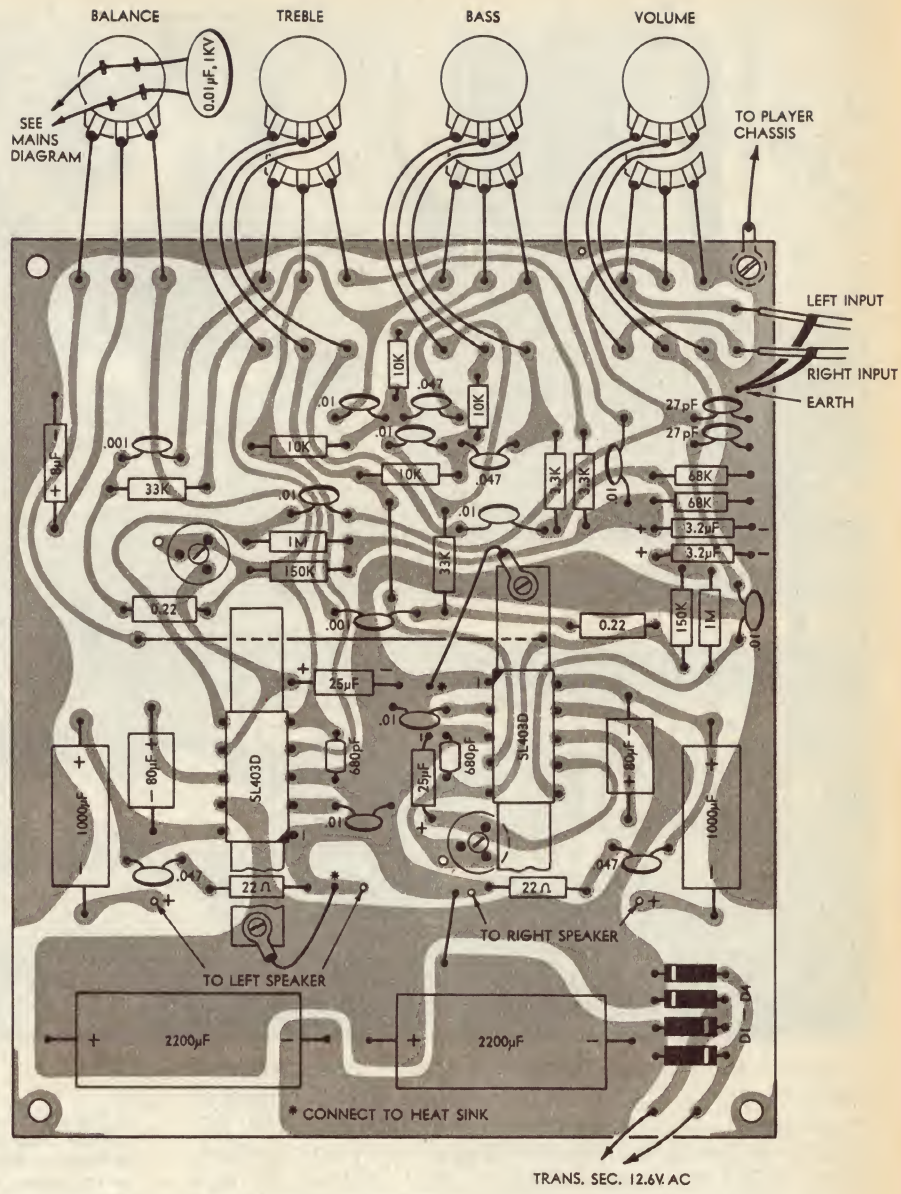
The remaining job of wiring is to connect the pickup cartridge through to the amplifier board.

If you have bought a complete player deck it is likely that the wires coming from the cartridge (usually through the pickup pillar) will have been terminated on a tagstrip underneath the player frame. An instruction sheet will normally be available but, failing that, your supplier should be able to indicate the connections necessary.

Obtain a suitable length of twin-shielded cable which, again, your supplier should be able to provide. Trim back the outer plastic covering (if any) for about 1¼ inches at each end. Part the braiding, pull the shielded wires out through the side and twist the braiding so that you now have three conductors exposed at each end — the braiding and the two inner conductors.

One end of the cable connects to the tagstrip under the playing deck, the other to the amplifier board, as shown. If you have bought a separate pickup or the player has only short trailing leads it may be necessary to instal a tagstrip under the player chassis to provide a junction point. Try to identify the leads coming through from the cartridge and ensure that the respective "plus" or "active" leads connect to the shielded wires; the "minus" or "earthy" leads should connect together and to the braiding of the outgoing cable.

The choice of a record player or changer unit will be largely governed by the amount of money the constructor is prepared to outlay. Since the aim is to equal or improve on what is available commercially for a given outlay, we visited one of the large retail stores to check the prices of the inexpensive stereo systems by leading manufacturers.



Layout diagram, showing how the various components are distributed on the printed wiring board (board viewed from the component side). It is important that the flying leads from the boards to the IC heatsinks should have their solder lugs fastened under the heatsink fixing screw NEAREST TO PIN 1. If this layout is followed exactly, no problems should be experienced in the construction of the amplifier.

These ranged in price from around $49 for a 1-watt per channel system with 0.5 cu ft enclosures and single record player, to $109 for a 3-watt per channel system with 1 cu ft enclosures and record changer. Rather more expensive systems, starting at around $200, had larger enclosures with multiple speakers, more controls and extras which tended to put them outside the economy class.

Simple player decks of the type found in the cheaper type of commercial units can be bought for as low as $8 for a single play unit, and around $28 for a changer.

The player selected should have a crystal or high output ceramic cartridge. Low output ceramic cartridges, such as the Decca Deram, are not suitable; they are not capable of driving the amplifier to full output and, even with the volume control fully advanced, you are likely to find that the unit is not giving you sufficient volume.

Rather more elaborate changers, such as the dearer ones in the BSR/MacDonald and Garrard ranges, would represent the top end of the units home constructors are likely to use in a system of this kind. In selecting a player, much will depend on whether the present system is to be an end in itself or whether the player is to be used later in an upgraded system.

A simple player stand is easy enough to make from wood oddments and the handyman will probably prefer to provide his stand this way. Ready-built stands range from about $6 without plastic cover and start at about $12 with cover. Kits for both types are available at somewhat lower cost.

A fine brandy, a good cigar, a relaxing atmosphere—and the SONY TC-630. Some people want the best of everything. And in sound reproduction SONY'S TC-630 is supreme, with its thrilling concert hall realism. It's a complete stereo music control centre with multiple inputs for phono, tuner, microphone and auxiliary. Functions independently as tape recorder, amplifier and deck. Want to conduct your own personal orchestra? The SONY TC-630 lets you do it—superbly.

SONY®

JACOBY KEMPTHORNE

SYDNEY: 26 2651, MELBOURNE: 329 6866, ADELAIDE: 53 6117, BRISBANE: 21 0586, PERTH: 28 5725, LAUNCESTON: 25 322, Agents: CANBERRA: 47 9010, NEWCASTLE: 61 4991, PORT KEMBLA: 84 8022.

TO: Jacoby Kempthorne, 469-475 Kent Street, Sydney, N.S.W. 2000
Please send me, without obligation or cost, information on the TC-630.

NAME _____

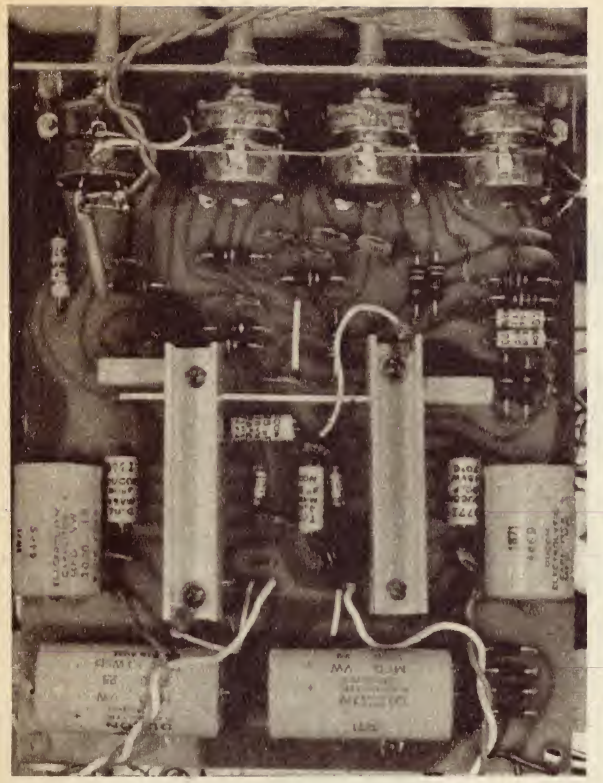
ADDRESS _____

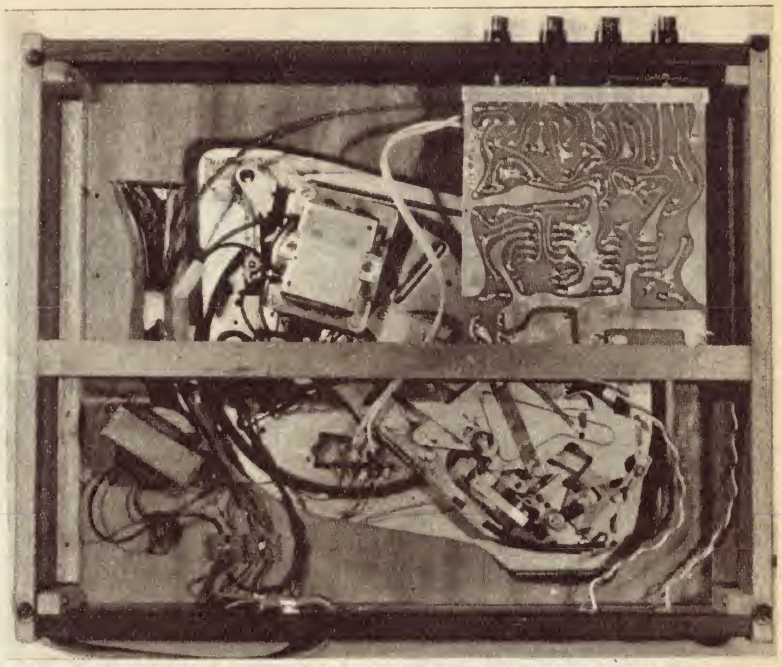
_____ POST CODE _____

SN2859

SPECIFICATIONS

- Recording system: 4-track stereo/mono recording playback
- Power requirements: AC 240V, 50Hz
- Power consumption: 85 watts
- Tape speed: 19cm/s (7½ ips), 9.5cm/s (3¾ ips), 4.8cm/s (1⅞ ips)
- Reel capacity: 18cm (7") or smaller
- Frequency response: 30-22,000Hz at 19cm/s, 30-13,000Hz at 9.5cm/s, 30-10,000Hz at 4.8cm/s
- Bias frequency: 160 kHz
- Flutter and wow: 0.09% at 19cm/s, 0.12% at 9.5cm/s, 0.16% at 4.8cm/s
- Power output: Lid speaker, 7.5 watts per channel, 20 watts dynamic power, External speaker, 15 watts per channel, 40 watts dynamic power
- Signal-to-noise ratio: 50 dB
- Harmonic distortion: 1.2% at rated output (overall)
- Level indication: Two VU meters
- Recording time (1,800' tape): 4-track stereo, 6 hours at 4.8cm/s; 4-track mono, 12 hours at 4.8cm/s
- Fast forward and rewind time: (1,200' tape) Within 2 minutes and 30 seconds
- Inputs: Microphone input, Sensitivity -72dB (0.2mV), impedance 250 ohms; Tuner input, Sensitivity -22dB (0.06V); Impedance 100k ohms; Auxiliary input, Sensitivity -22dB (0.06V), impedance 560k ohms; Phono input, (MM or MC cartridge), Sensitivity -52dB (2mV), impedance 14k ohms
- Outputs: Line output, Output level OdB (0.775V), impedance 100k ohms Headphone output, Output level -28dB (30mV), Impedance 8 ohms; External speaker output, impedance 8 ohms, Lid speaker output, Impedance 16 ohms
- REC/PB connector: Sensitivity -40dB (7.75mV), Input impedance 10k ohms, Output level OdB (0.775V), Output impedance 100k ohms
- Dimensions: 17⅞ x20x11⅝"
- Weight: 46 lb 3 oz





LEFT: This is how your printed wiring board should look when assembly of components has been completed. Note the flying leads to the IC heatsinks. RIGHT: Underside view of the completed prototype unit, with printed wiring board, power transformer and loudspeaker sockets in position.

We come now to the matter of loudspeakers.

While it is possible to make up small enclosures using cheap 3in or 5in loudspeakers, they are capable of only very limited performance.

Their frequency response is poor, particularly at the bass end. Their power handling capacity is limited, so that they tend to overload at loud volume. Their acoustic efficiency is low, which means that they do not produce as loud a sound for a given electrical input as do more efficient loudspeakers.

Fortunately, local manufacturers produce modestly priced loudspeakers eminently suitable for a budget system — and these may be housed in enclosures as recommended by the manufacturers themselves, or in certain designs that we have published in the past.

In selecting loudspeakers for a modest amplifier system, good acoustic efficiency is essential. Your parts supplier should be able to give some guidance along these lines but one of the pointers is the strength (and cost) of the magnet structure. If you are faced with two loudspeakers identical apart from the magnet, go for the one which has the highest magnetic flux in the voice coil gap. As far as the end result is concerned, an increase in sensitivity (or efficiency) is equivalent to an increase in amplifier power.

At the same time, avoid loudspeakers which have large magnets but also large voice coil air gaps and very compliant cone assemblies. Loudspeakers like this are usually rather insensitive and are intended for use with more pretentious amplifiers having power and gain to spare.

If cost and space were no object, the amplifier could be operated to advantage into a pair of sensitive 12-inch loudspeakers fitted into suitable enclosures. The results would certainly be impressive but the cost and bulk of the large loudspeaker systems would be disproportionate.

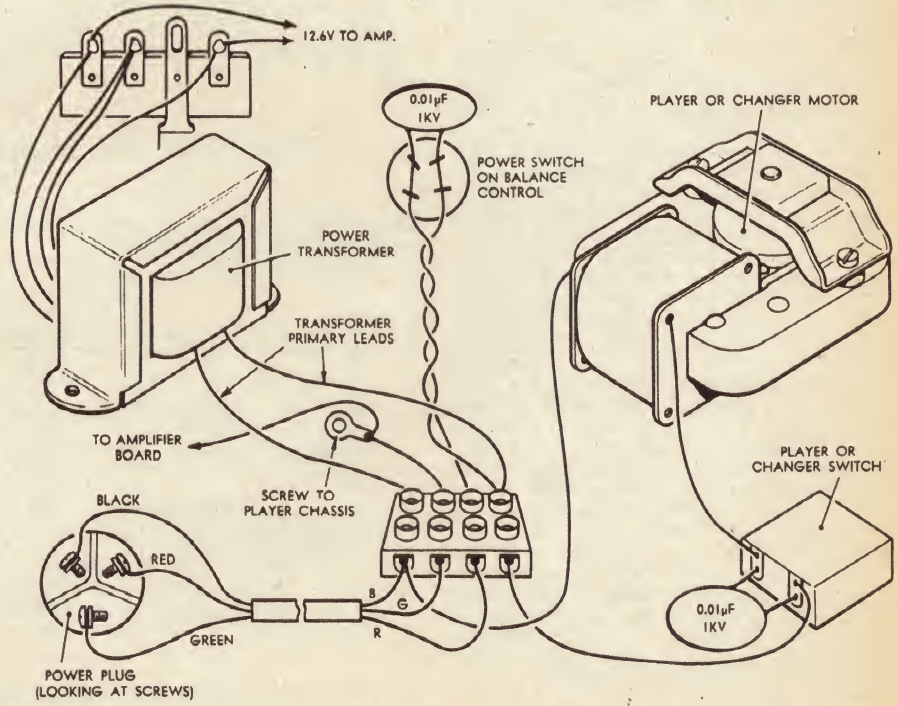
Even 10-inch loudspeakers with suitable enclosures might be open to the same criticism and the more logical choice would be either 8-inch or 6-inch types fitted into suitable vented enclosures.

While ready-built enclosures can be bought, the handyman can save quite a few dollars by building his own, either from a kit or raw materials.

Details of "An Economy Loudspeaker System For Low Power Amplifiers" appeared in the November 1970 issue. The article described the construction of a vented enclosure measuring 11 inches wide by 9 inches deep by 20 inches high. It will suit a standard 8-inch loudspeaker such as the Rola C8MX, the MSP 8/TACX or the Magnavox 8PIX. All of these are twin-cone types with reasonable sensitivity, wide frequency response and adequate power handling ability.

We have reasonable stocks on hand of the November 1970 issue but, in any case, copies of the article can be supplied through the Information Service for 50c.

(Continued on page 45)



This layout diagram should be carefully studied and followed when wiring the 240V power circuits, to ensure safe operation.

Solid State Automotive Voltage Regulators

A discussion of solid-state voltage regulators for automotive electrical systems. The author looks at a previous design, suggests improvements and extends the concept to accommodate both polarities. Finally, he describes similar control systems suitable for use with alternators.

by D. C. SOWDEN, BSc., M.I.E. Aust., M.B., B.S.

In the "Reader Built It" series for May, 1967 (reprinted June 1970) a circuit and description for a solid-state voltage regulator for a negative chassis DC generator system was published (figure 1).

Using this as the starting point, the following developments are discussed in this article.

(1) Improvement of regulation characteristics.
(2) A circuit for positive chassis systems.
(3) Optional facilities which eliminate the need for internal generator modifications.
(4) A simple attempt at temperature compensation.
(5) Regulation of automotive alternators. Developments from figure 1 for solid-state alternator control are given.

The purpose of the current regulating function is solely to prevent more than the maximum rated current being drawn from the generator. Ideally, no regulation should begin until the output rises to the rated maximum for the generator, after which generator output would remain constant (see figure 2). (Relay regulators approximate closely to this performance). The performance of the type of regulator represented by figure 1 is shown in figure 3.

This curve shows that the regulator is imposing a further degradation of performance on the already marginal low speed generator characteristic. This effect will be greatest when the threshold current is low (corresponding with low regulator sensitivity) and least when the threshold current is high (corresponding with high regulator sensitivity). The highest regulator sensitivity requires the highest practicable regulator amplifier gain.

It was considered after testing a regulator of similar sensitivity to that of figure 1, that provision of higher sensitivity would provide a worthwhile improvement in performance. An extra transistor was added in composite connection with the output transistor, leading to the circuit of figure 4 for negative chassis systems. The circuit was rearranged to use type AY8108 in the output stage, as this type has advantages which will be discussed later. The final gain had to be reduced by adding R10, which together with the capacitor across R8, was required to prevent "hunting".

A corresponding high gain circuit for positive chassis systems is shown in figure 5.

In the original circuit (figure 1) the cutout relay was eliminated by using a power diode. For reasons explained in the May 1967 article, this led to a need for internal generator modifications to bring out the chassis ends of armature and field to a new terminal isolated from the frame.

The question arises — is the removal of the cutout relay so very necessary, considering the generator modification required? Most of the objections to mechanical relays are aimed at the regulator relays, and cutout relays do not give much trouble. Options have therefore been included which permit the cutout to be eliminated or not as desired. Retaining the cutout makes generator alteration unnecessary. The circuit will regulate with either option, although adjustment settings are different for each.

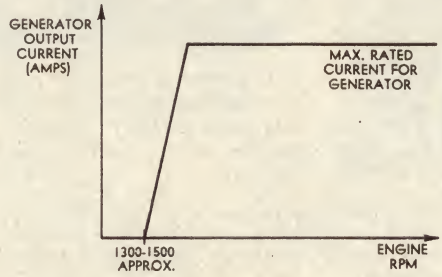


Figure 2

. An ideal current regulator curve. Relay regulators approximate this very closely.

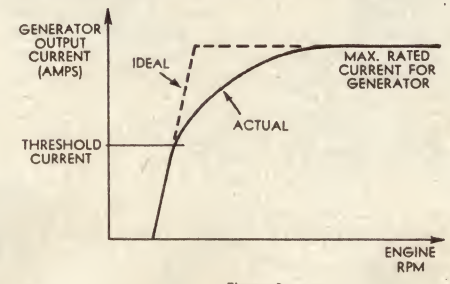


Figure 3

The actual current regulator performance provided by the circuit in figure 1.

The cutout relay is housed in the original regulator box, which will have to be retained if the cutout is to be retained. A separate box is then required for the electronic regulator. In this series, small diecast aluminium boxes were used.

Internal modifications to the original relay regulator are not required. The generator field connection is transferred from the old to the new regulator, leaving the regulator section of the old regulator still connected internally, but no longer controlling the field.

An extra damper diode is included in the electronic regulator from output to chassis to suppress transients from the cutout relay coil.

The operation of the circuit is as follows: Resistors R1, R2, R3 (with the parallel thermistor) constitute an adjustable voltage divider across the battery. When voltage is low, the zener diode does not conduct, therefore TR1 base and collector currents are zero. R8 supplies full base current to the composite pair TR2, TR3 which supply full field current. When the battery voltage rises, the zener diode begins to conduct, supplying base current to TR1, which in turn diverts current away from TR2 base. Field current and therefore generator output drop. Adjustment of the voltage limit is by varying R2.

Current limitation to protect the generator is provided by R6 (0.01 ohm). When generator output current flows through R6, the voltage developed across it forward-biases TR1. This

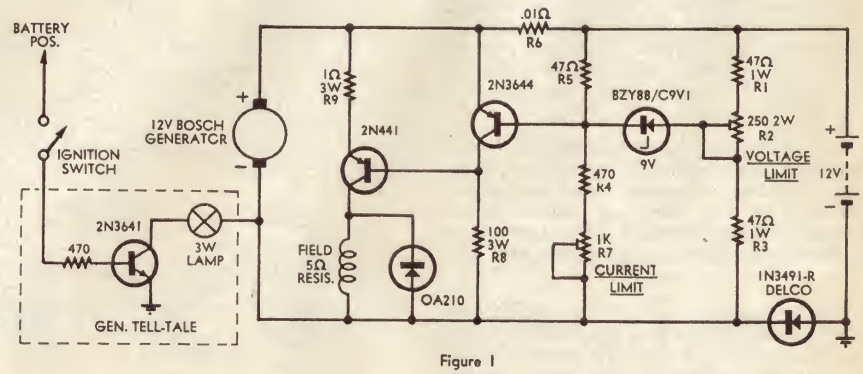


Figure 1

The solid state voltage regulator as originally presented in the May 1967 issue. It required that the generator be modified to insulate the chassis ends of both the armautre and field windings. The author of this article uses it as a starting point.

reduces the field current as before. R7 provides means of adjusting the current limit.

The power transistor chosen was Fairchild AY8108 for both positive and negative chassis systems. It requires no heatsink. A feature of this type is that it contains integrated emitter resistors which help to prevent thermal runaway. Resistor R9 can be omitted if desired, further improving generator output at low speeds, though it provides some protection against accidental short circuiting of the field winding. For this reason it was left in the prototype circuits.

Temperature compensation is provided by replacing R3 (originally 47 ohms) with 68 ohms paralleled by a thermistor. This certainly produces temperature-sensitive behaviour, though it was not rigorously temperature-tested.

When the temperature is low, the thermistor resistance is high, making R3 high, in effect. This shifts the voltage tap on the divider network so as to make the voltage applied to the zener diode low, reducing or stopping zener diode current.

This increases generator output. When the temperature rises, the thermistor resistance falls, producing the reverse effect. This provides an initial "booster" charge when it is most needed; after first starting up for the day when a cold engine has required maximum cranking effort.

The regulator unit containing the thermistor should be mounted in the engine compartment, so that heat from the engine and radiator will warm it. Final voltage adjustment is always carried out when the engine is well warmed up.

Individual constructors may prefer to omit the thermistor. In this case R3 reverts to the original value; 47 ohm 1 watt.

The specification for the heavy duty 0.01 ohm resistor R6 has been changed. It was thought that fencing wire may give trouble with rusting connections. A 2'6" length of 3/0.029 standard plastic-covered copper wire (used by electricians to wire houses) was wound on a cotton reel. A 1'11" length of the more common 1/0.044 wire also provides the same resistance but would be more liable to fatigue failure due to its single conductor.

To adjust the system, connect an ammeter into the battery lead. Inactivate the voltage regulator part of the system by turning the voltage limit control to its highest voltage setting (R2 zero). Start engine. With lights and accessories off, adjust R7 so that the maximum charging current is at the desired figure. This

Suggested changes to the original circuit to take advantage of the improvements in the later design.

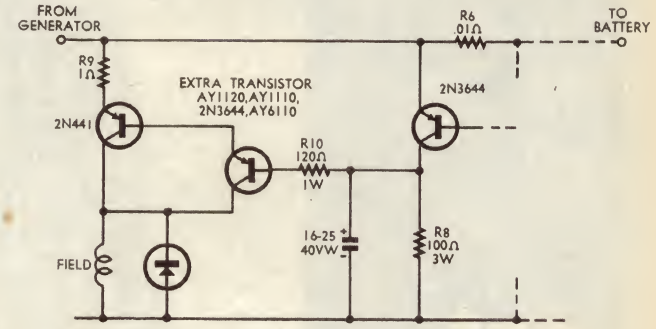


Figure 6

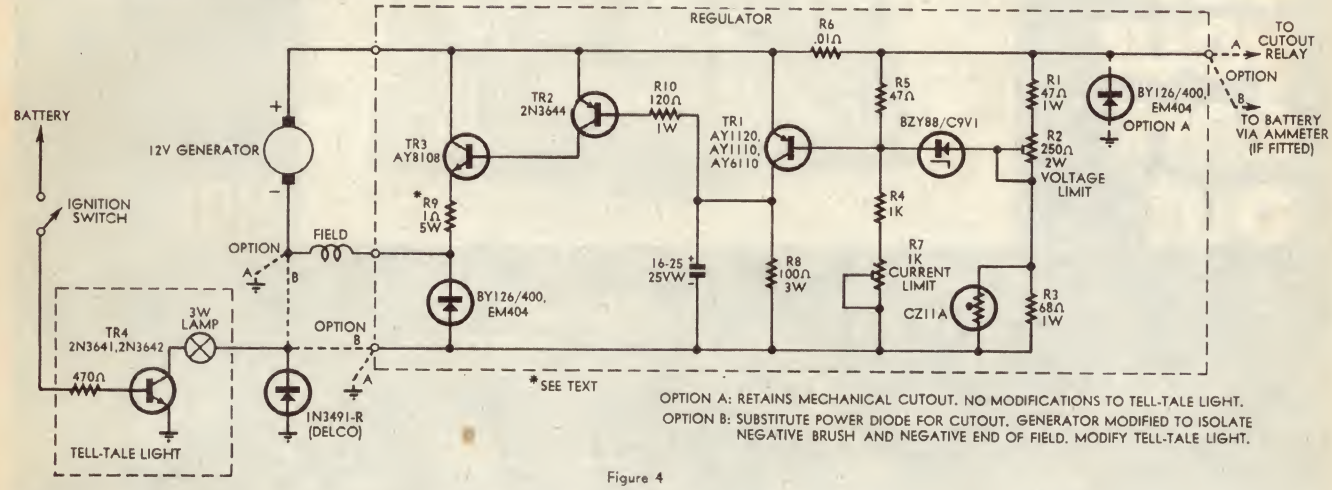


Figure 4

Solid-state regulator for generator type systems having negative chassis. A major feature of the circuit is the additional transistor, higher gain, and improved regulator characteristics which these provide.

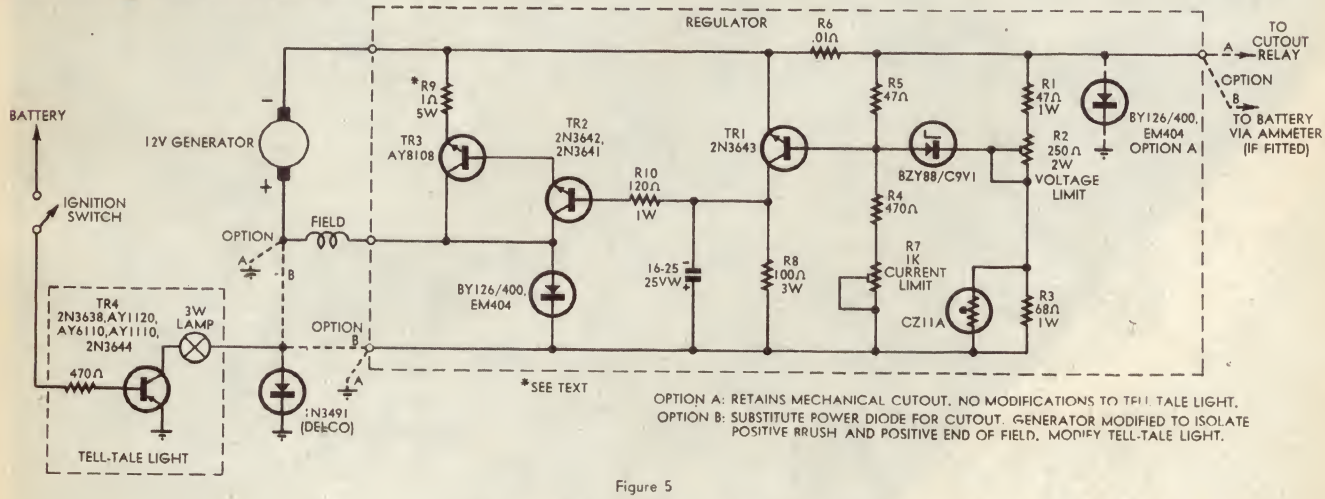


Figure 5

This circuit is similar to that of figure 4, except that it is designed for positive chassis systems. Note that in both circuits the dotted connections provide for mechanical cut-out or diode operation, as the user prefers.

will be between 20 and 30 amps, depending on the generator rating.

Make a temporary adjustment to the voltage control (R2) to provide a moderate charge rate and thus enable the battery to be brought to full charge. The final adjustment is made after a short run, to fully charge the battery and warm the thermistor. Resistor R2 is adjusted for a "trickle" charge of about 3A.

If alternative components are being considered, the following points will serve as a guide.

Zener diodes: Any 9-volt 400 mW or moderately larger unit is suitable.

Damper diodes: Any silicon power rectifier diodes (preferably with a high voltage rating) are suitable.

Transistors: In TR1 and 2 positions, other silicon transistors could be tried if the following conditions are met:

1. Correct Polarity (NPN or PNP).
2. Medium to high gain (hFE 50-200).
3. Satisfactory power ratings, eg. T05 package type.
4. Preferably low VCE (Sat) figure, less than 1 volt.

TR3 should not be changed unless the constructor can be sure that adequate heat-sinking arrangements can be made. For negative chassis systems, germanium type 2N441 using the mounting box as heatsink can be used, as in the original circuit. Types 2N3055 and 2N3054 can also be used.

Thermistor: Type CZ12 is sufficiently close to be substituted.

The voltage control performance is excellent. On starting in the morning, a high rate charge occurs, settling to a low trickle charge on a steady run with a fully charged battery. After this is achieved, even a few seconds battery discharge is compensated for by a brief rise in the charge rate.

Beyond a minimum value, variations in engine speed have no detectable effect on the charge rate. This is in contrast to the original regulator, where this was not achieved.

The temperature compensating system produces a noticeable difference in the charge rate before and after the engine is warmed up. This is in addition to that expected due to the changing battery voltage. Current control performance is improved on the original circuit.

For those who built a unit according to the original design (figure 1), the following simple modification is suggested. (Figure 6).

An extra transistor (eg, AY1120, AY6110, AY1110, 2N3644) is simply added in Darlington Pair configuration with the 2N441, and components R10 and the capacitor across R8 added. The thermistor and 68 ohm resistor may replace R3 (47 ohms). R4 may require changing to 1K to ensure a good range of adjustment of R7.

Modern automotive alternators are three-phase types having built-in groups of diodes to perform three-phase rectification. They can therefore be treated as sources of direct current. Compared with DC generators, they differ considerably in performance and control arrangements. Some of these differences are:

1. As the alternator rotor can withstand higher rotational speeds, the pulley diameters are arranged so that the ratio alternator RPM/engine RPM is higher than in the case of the DC generator. This leads to improved output at low engine speeds. (This is particularly useful, as average speeds have been falling in urban areas, due to increasing traffic congestion.)
2. Because of their design, alternators are self-protecting with respect to current loading. No current regulator is required, as it is impossible to overload these machines.
3. No cutout is required, as the rectifier diodes

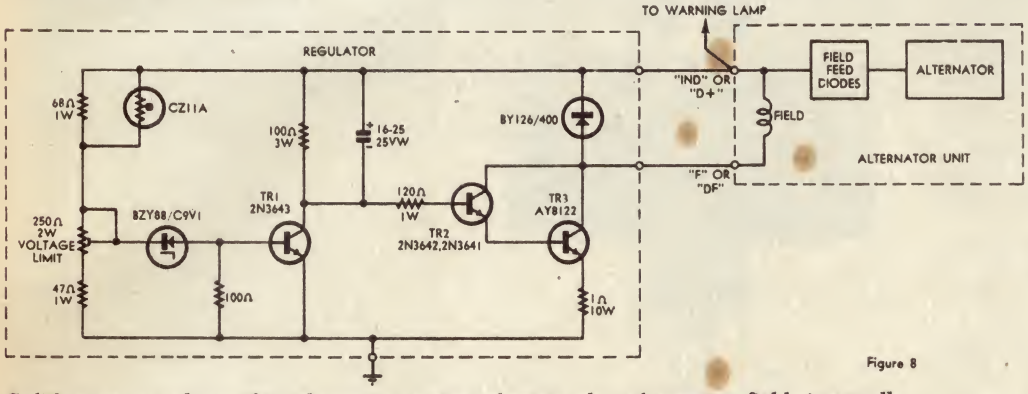


Figure 8

Solid state regulator for alternator system having the alternator field internally connected to the "IND" terminal. Many of the Lucas alternators use this arrangement. No current control components are required with alternators.

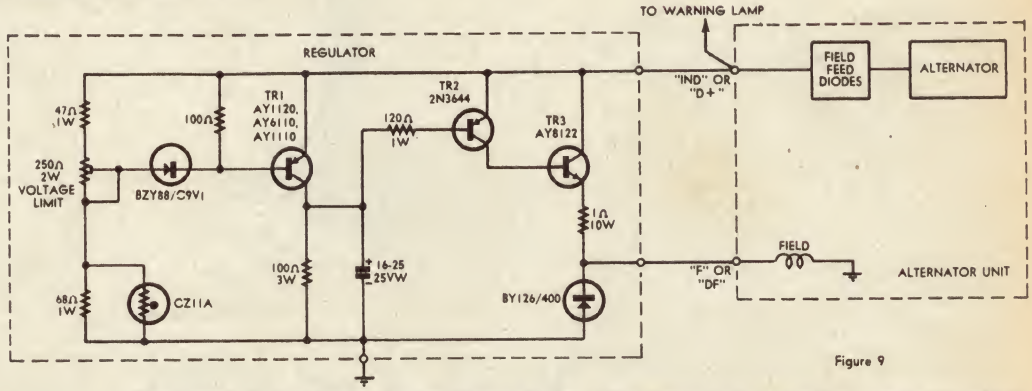


Figure 9

This circuit is similar to that of figure 8, but is designed for use with systems in which the internal field connection is to chassis. Many of the Bosch alternators are examples of this arrangement.

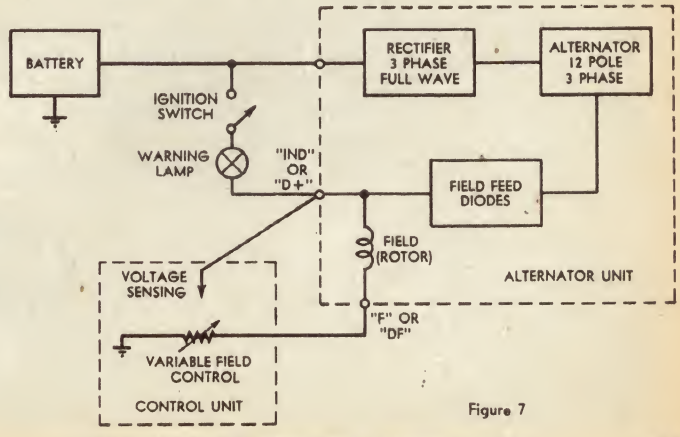
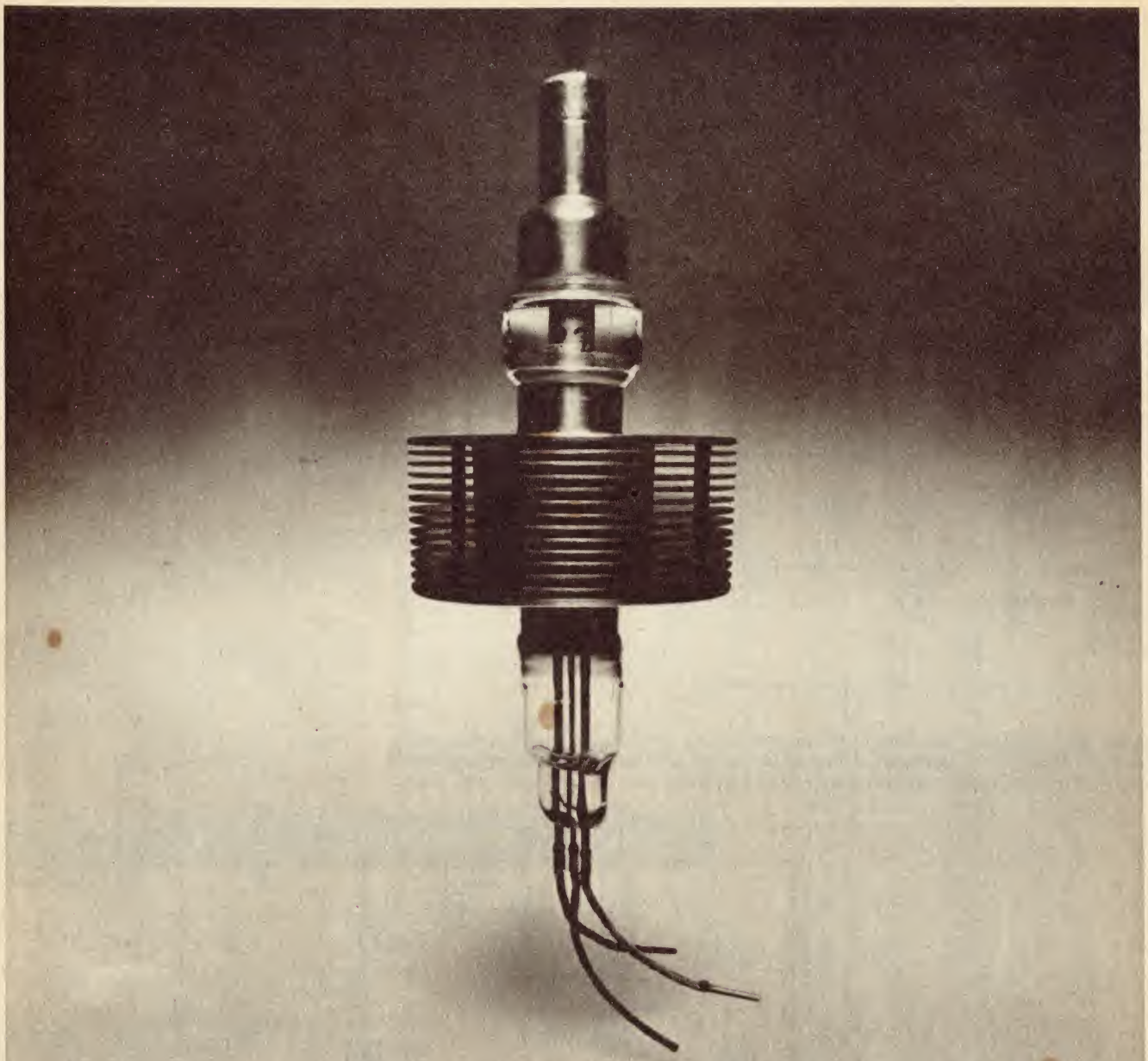


Figure 7

Block diagram showing a typical alternator set-up. Note that two sets of diodes are used, one for the main charging circuit and one for the field.



Work of art 5786

A concept in argon-cast copper; the beautiful shape of a living idea. The AWV 5786 beam power tube, power centre of D.C.A. Distance Measuring Equipment beacons throughout Australia. A power unit with a pulse of two kilowatts concentrated in 5 microseconds conceived for the function of outlining the nation's airways.
Here, intelligence of function creates its own beauty of design. And technology becomes art.
For AWV. electronics is a living art.

AWV

your experts in the art of electronics.

prevent reverse current flow from the battery through the alternator.

4. There is very low residual magnetism. Initially an external source of field current (derived from the battery) is needed to produce enough field excitation. As the output voltage builds up, the alternator becomes self-exciting. Field excitation in most types is supplied by a separate set of diodes (field feed diodes) providing three phase half wave rectification.
5. The rotor is the field winding. The output comes from the stator. (The reverse compared with DC generators.)

Figure 7 shows a typical alternator charging setup. On switching on, current flows from the battery via the warning lamp (which glows) through the field winding and ultimately to chassis via the regulator. This provides initial field excitation for the alternator. When the engine runs, the output of the alternator, rectified by the field feed diodes, progressively builds up the voltage at "IND" (indicator) to approximately battery voltage, so that the warning light is extinguished, and the machine becomes self-exciting; the field current being supplied from the alternator-field feed rectifier combination.

The regulator, whatever its type, monitors the output voltage of the alternator (usually at the field feed diode output, though sometimes at the main output) and introduces some means of variable control into the field circuit to reduce output when required.

At the time of writing, most commercial alternator regulators do this by switching the field current on and off quickly. The higher the proportion of "on", the higher will be the average output. The Lucas regulator performs this switching electronically, using a solid-state circuit. Most other makers use a vibrating regulator relay system. (In this case the changeover of field excitation from battery to field feed diodes may be achieved by a second relay which operates when the alternator is fully functional.)

The same arguments against vibrating mechanical contacts can be applied here as were used in the original 1967 article relating to DC generator control (wearing, sticking, pitting, etc). All "switching" type regulators, whether mechanical or solid state, may be criticised as being prolific producers of transients, requiring careful radio suppression, and also placing greater stress on the bearings by varying the load quickly.

Figure 7 shows an internal connection between the field and "IND" or "D+" terminal, normally at approximately battery potential during operation. This applies to Lucas alternator types 14AC and 15AC. In most other types, especially those using vibrating relay regulators, the internal connection is between field and chassis instead, with the variable control placed externally between "IND" (or "D+") and "F" (or "DF").

The Bosh alternator model U-LJ/DK1/35A 14VR is an example of this type. The Lucas 15AC alternator may have the internal field connection changed to chassis very easily, if desired, with no other dismantling except removal of the cover.

The position of the internal connection makes a big difference to the details of the control circuit required.

Two circuits for solid-state alternator regulators with continuous field current (not rapidly switched) are shown in figures 8, 9. Figure 8 is for those having the field internally connected to "IND"; figure 9 is for those having the field internally connected to chassis (the majority of types).

Figure 8 is similar to figure 5 upside down. Figure 9 is similar to figure 4. In each case, the current-control components are omitted. Except for this omission, the regulating action and adjustment are identical with the corresponding DC generator circuit.

These circuits are suitable for slip ring alternators having separate field feed diodes, which excludes Email alternators as fitted to Falcon XR and perhaps other models. These will be discussed later.

A detail of design is the specification of a larger power transistor (AY8122) because of the high field current drawn by alternators generally, the field resistance being lower than for DC generators. (The Lucas alternators, for example, have field resistances of only 3.3 ohms.) As alternatives, two AY8108 in parallel would be suitable, and cheaper types such as 2N3055, 2N3054, could be used, with the mounting box as a heatsink.

A 1-ohm external emitter resistor for the power transistor was included in the prototypes as a means of partial protection against accidental short circuits of the field winding. Types AY8122 and AY8108 have integrated emitter resistors which reduce the need for an external emitter resistor for thermal considerations.

There are numerous complexities in providing a fully solid-state regulator for Email alternators, due to the absence of separate field feed diodes. It is doubtful if adapting to any form of solid-state control is worthwhile.

For those interested in a compromise, it is suggested that the field relay be retained in the original regulator, while using figure 9 for the regulator function. The wire joining "F" on the old regulator and "F" on the alternator is removed at both ends. The old regulator "F" connection is used in place of "IND" on figure 9, the alternator "F" is used as terminal "F" on figure 9. The old regulator cover is removed, and one end of the regulator relay coil is disconnected and insulated. This relay has the changeover contact, which should identify it. (The field relay has a make contact.)

ACKNOWLEDGEMENTS: Thanks are due to Mr P. D. Kay, BE for the assistance gained from his helpful original article, "Solid State Voltage Regulator" ("EA" May 1967, p 93) and to "Electronics Australia".

SIMPLE STEREO SYSTEM — continued from page 39

If a more compact enclosure is preferred, we would suggest a design in the February 1971 issue, originally involving the Rola C60 6-inch "woofer" and an associated C3GX "tweeter" loudspeaker. While designed specifically for this combination, the enclosure should work well enough with a normal good quality 6-inch twin-cone loudspeaker. In this case, do not cut the hole for the tweeter and operate the enclosure the other way up so that the loudspeaker is at the top rather than the bottom.

Again, copies of the issue are available, or of the article.

Care must be exercised when connecting the loudspeakers of a stereo pair to ensure that they are connected in phase — which means that, with signals common to both channels, two cones tend to move in the same direction at any given instant. If they are not correctly phased, the stereo definition is prejudiced and the bass from the respective channels tends to cancel rather than to add. We suggest you wire the loudspeakers in the following manner:

The plugs and sockets used for connecting the loudspeakers should be a polarised type — an inexpensive two-pin type with one thick and one thin pin is a good choice. The connecting lead should have a coloured strip along the length of one conductor. This type of lead is not unduly expensive, and is readily available from most suppliers of components.

Examine the loudspeakers to determine which terminals are "positive." These are usually coded with a positive (+) sign, or with a red spot, or with a coloured disc assembled as part of the terminal. The other (negative) terminal may or may not be coded with a minus (−) sign, or a black spot.

Take the conductors through a small hole drilled in the back of each loudspeaker enclosure; connect the conductor with the coloured strip to the positive terminal and the other conductor to the negative terminal.

Solder a polarised plug to the other end of the leads, with the colour coded conductor going to the thin pin in each case.

The matching sockets may be mounted in any convenient position on the turntable base. Ascertain which of the terminals on the rear of the sockets relate to the thin pins of the plugs, and connect these to the "hot" side of the output in each channel — those fed by the 1000uF capacitors. The terminal connecting to the thicker pins will then be connected to the amplifier earth.

Well, your system is now complete. Your amplifier is mounted in the turntable base with the power supply, the pickup leads are terminated at the amplifier, and the loudspeakers are connected. But don't be in too much of a hurry to switch on.

Take a little time to check over the system for possible errors first. If everything looks in order, set all potentiometers, including the preset pots on the printed board, to about mid position, plug in to mains power and switch on.

A slight thud from the loudspeakers, followed by slight hiss and perhaps a barely audible hum, would indicate that things are probably normal. With multimeter, measure the DC supply rail voltage between the positive terminal of the filter capacitor (marked 18V on the circuit diagram) and chassis. Do not worry if the reading does not show exactly 18V, as some variation (between 16 to 20V) is not uncommon.

Now place the meter probe on the positive terminal of the loudspeaker coupling capacitor (connected to pin 10 of the IC) of one channel and, by adjusting the preset pot in that channel, set the voltage at that point to exactly half of the supply rail voltage. Now repeat the procedure in the other channel.

This adjustment is essential for optimum performance. Constructors who do not own a multimeter are advised to try to borrow one if they do not want to be committed to the expense of buying, or they should ask a friend who owns a meter to do the adjustment.

With this adjustment completed, touch a finger to each input terminal in turn. If the volume control is at mid position, as previously suggested, a fairly loud hum should be audible from the appropriate loudspeaker. This indicates that both channels are active.

At last comes the moment to set a record on the turntable, and to enjoy the clean low distortion sound that this inexpensive system is capable of providing. We have a feeling that this is going to be a popular project, and that many home constructors will be surprising their friends when they demonstrate the good quality sound they have achieved for such modest outlay.

Philips dynamic noise limiter for cassette tapes

by LEO SIMPSON

Much interest has been generated over the past few months in overseas journals in dynamic noise reduction systems such as the Dolby system. In this article we take a closer look at the Philips Dynamic Noise Limiter System. Fully compatible with present cassette machines, it is interposed between the cassette deck and stereo amplifier.

Last month in an article entitled "Hi-Fi Scene" we described the latest developments in cassette tapes and in particular, detailed the problems of compatibility between Dolbyised tapes and conventional cassette machines. The Philips noise reduction system was mentioned but not many details were given.

Recently, "Wireless World" published further details of the Philips system and this has enabled us to evaluate the circuit and its performance under typical conditions.

Basically, the Philips system is a dynamic treble-cut tone control circuit which operates on playback only. It does not involve any pre-conditioning of the recording, as does the Dolby system. It uses a steep top-cut filter which is inoperative when the program signal is loud and contains a substantial high frequency content. Under these conditions the noise is effectively masked by the program and noise reduction is not needed, anyway.

When the high frequency components of the program signal fall below a certain amplitude, the filter system becomes operative, heavily attenuating the noise and signal components above 4.5KHz. In this way the overall system exhibits flat response to high level signals but a rapid treble roll-off for signals of low level or having very little high frequency content.

Four transistors and six diodes form the basic noise reduction circuit. The first stage uses a silicon NPN transistor, Trl, as a phase-splitter. Signals out of phase with the input are fed directly to the output capacitor via the 4.7K preset resistor. Signals in phase with the input are fed from the emitter of Trl to an active high-pass filter consisting of the silicon NPN transistor Tr2 and associated components.

High frequency signals from the collector of Tr2 are further amplified by Tr3 and Tr4. Tr4 also functions as a phase-splitter. Signals from the collector of Tr4 are half-wave rectified by the silicon diodes D1 and D2 to develop a positive voltage across the .0047uF capacitor associated with D1 and a negative voltage across the .0047uF capacitor associated with D2. If the input signal is sufficient, the DC voltages so developed will forward bias diodes D3 and D4 into conduction so that high frequency signals fed from the emitter of Tr4 via the 22K resistor are shorted to ground.

If D3 and D4 are fully conducting, there is no treble attenuation of the output signal. If the voltages developed by D1 and D2 are not sufficient to bias D3 and D4 into conduction, the high frequency signals from the emitter of Tr4 are fed to the output via the 22K and 120K resistors so that they cancel the high frequency components of the output signal.

A signal voltage limiter formed by the two cross-connected diodes associated with the base of Tr3 prevents excessive voltages being fed to D1 and D2 and ensures a fast decay characteristic for the "compressor function" performed by D3 and D4.

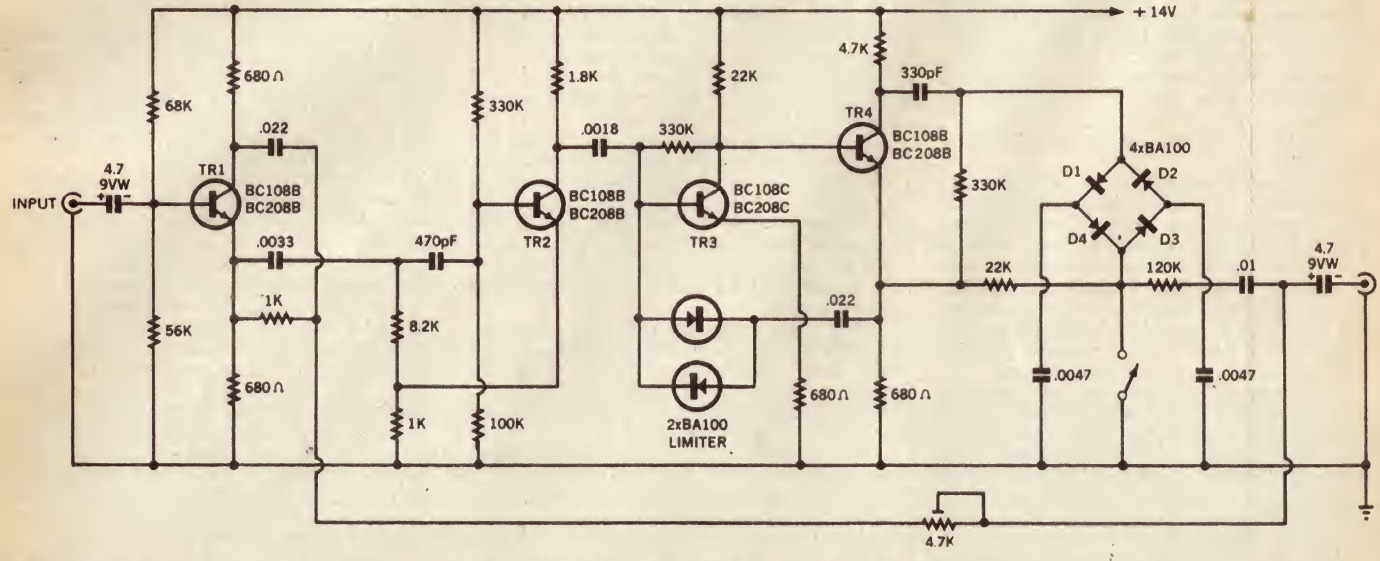
The noise cancelling function of the circuit is defeated by closing the SPST switch which shorts the junction of the 22K and 120K resistors to ground. This prevents high frequency signals from the emitter of Tr4 reaching the output and causing resultant HF attenuation of low-level signals.

Overall voltage gain of the circuit is approximately one, allowing the unit to be interposed between the cassette deck and the high level tape inputs of the stereo amplifier, with minimal change in the behaviour of the system.

As presented, the Philips noise-reduction circuit is not a great deal less complicated than the B-type Dolby circuit. However, an advantage claimed for the Philips system is that it benefits non Dolbyised tapes, i.e., the majority of pre-recorded tapes on the market today. Philips claim an effective improvement in signal-to-noise ratio of 10dB at 6KHz and 20dB at 10 KHz. In terms of figures, this is better than achieved by the B-type Dolby system although, of course, that is not the full story.

To verify the performance claims, we decided to mock-up the circuit and try it out in typical listening conditions. The semiconductors specified by Philips are not easily available in Australia but we used close equivalents and these are shown on the circuit diagram.

For optimum noise performance, the 4.7K preset resistor must be adjusted to give minimum hiss with a low level signal ap-



The Philips noise reduction circuit has a treble response which is dependent on signal level.

plied. The preset resistor does not affect the "threshold" at which the circuit comes into operation — this is set by other circuit components, the diodes D1 to D4, in particular. We found that, for signals above 5KHz and below 10mV RMS in amplitude, the circuit does give very heavy attenuation as claimed. For high level signals, the circuit has a flat response.

With signals above 5KHz and having an amplitude of 20 to 30mV RMS, some waveform clipping occurs. This is because the diodes in the output stage are only just biased into conduction on the peaks of the signal — this is the threshold level. In practice, the distortion caused by this clipping may not be directly apparent, because of the very high frequencies involved but other factors may intrude.

For best noise performance, the circuit must be driven with signals having an average level of about 300mV or more. If the signal level is too low, the treble attenuation function will operate almost continuously. If the signal level is too high the hiss component will not be cancelled effectively.

Our first listening tests were done with normal mono cassette machines with a price under the $100 mark. With these machines, the noise reduction circuit made little difference — the frequency response of the machines was such that hiss was not a problem anyway. In fact, with these machines the amplifier's tone controls can even be set for modest treble boost without hiss becoming a problem.

With more ambitious stereo cassette machines, costing around $200 or more, hiss can be a real problem and here the Philips circuit works well. On quiet passages it effects a dramatic reduction in hiss but some listeners would claim that this was noticeably at the expense of the treble response — even if only at low level. Most listeners, however, would regard the overall effect as an improvement.

On the debit side, we did notice that on programs with rapidly varying signal levels, the transients appeared distorted. Close listening seemed to suggest that the signal itself was not distorted but that it was modulating the hiss. At the beginning of a transient or loud, impulsive note, the treble attenuation function of the circuit is, or can be, fully operational. But as the signal rises to its maximum level, the diodes at the output conduct, cancelling the treble attenuation condition and allowing the hiss to "ride in" on top of the signal, ie, the rapidly varying signal switches the hiss on and off!

To some listeners, this effect could be unpleasant enough on some tapes to outweigh the overall advantages of the circuit. But, in general, it is merely an effect we noted and would not be unduly apparent to the average listener.

To sum up, if the reader has a high quality cassette machine and is bothered by the high hiss levels on many pre-recorded tapes, this circuit may be well worth a trial. For best effect, the machine should have a signal level output of about 300mV or more and preferably have a level control to adjust for different tapes. The circuit could also be used with conventional reel-to-reel machines but its effect will be noticeable only at the lower tape speeds. If the reader has a run-of-the-mill cassette machine, the circuit will have little or no effect.

While the circuit shows a supply rail of 14

(Continued on page 125)

Sansui

Even the lowest priced Sansui stereo amplifier has low noise silicon transistors throughout.

BRIEF SPECIFICATIONS:

SANSUI MODEL AU-101
Power output:—
15 watts R.M.S. per channel.
Frequency response:—
20-60,000 Hz. ± 2 dB.
Distortion:—
T.H.D. Less than 0.8% at full output.
Sensitivity:— 3-200 mV.
Price:— $139.

SANSUI MODEL AU-999
Power output:—
50 watts R.M.S. per channel.
Frequency response:—
5-100,000 Hz. ± 1 dB.
Distortion:—
T.H.D. Less than 0.4% at full output.
Sensitivity:— 2-200 mV.

Sansui
SOUND SATISFIERS

If Sansui specify low noise silicon transistors in the Model AU-101 which costs only $139, you can imagine the electronic wizardry that goes into Sansui's more powerful and more costly amplifiers. Designed for the future, you get *more* in terms of *total performance,* no matter what *price* you pay.

The Sansui AU-101 *outperforms* many units which are more expensive and *runs rings around* any amplifier at the same price.

Then, of course, you may be seeking the ultimate solid state stereo amplifier. *You're looking for the Sansui AU-999.* Power output is 140 watts into 8 ohm speaker loads . . . and every necessary and desirable control facility has been incorporated. Frequency response is 15 — 70,000 Hz. + 0.5 dB., — 1.5 dB. And the AU-999 drives no less than *three* pairs of stereo speaker systems!

There are 18 amplifiers in the Sansui solid state stereo range . . . catering for every pocket and every possible technical requirement.

When you're investing in a stereo amplifier, listen to Sansui at your nearest franchised Simon Gray dealer. *Listen critically.* And you'll hear the *exciting* and *permanent* difference Sansui design and precision engineering makes.

Listen to Sansui soon!

Simon Gray Pty. Ltd.,
28 Elizabeth Street,
Melbourne. 3000.

Please send me details of Sansui stereo amplifiers, particularly the"

NAME.....

ADDRESS.....

.....POSTCODE.....

Sansui Distributors: Australia, excluding W.A.: Simon Gray Pty. Ltd. **Head Office:** 28 Elizabeth Street, Melbourne. 3000. Tel. 63 8101*. Telex: 31904. **Sydney Office:** 53 Victoria Avenue. Chatswood. N.S.W. 2067. Tel. 40 4522*. **Canberra Office:** 25 Molonglo Mall, Fyshwick, A.C.T. 2609. Tel. 95 6526. **Adelaide Office:** 301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6219. **N.T.:** Pfitzner's Music House, Smith Street, Darwin. 5790. Tel. 3801. **Qld.:** Sydney G. Hughes, 154-158 Arthur Street, New Farm. Brisbane. 4005. Tel. 58 1422. **Tas.:** K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 7250. Tel. 2 5322. **W.A. Distributors:** Carlyle & Co. Pty. Ltd., 1-9 Milligan Street, Perth. 6000. Tel. 22 0191. **Sansui equipment is manufactured by:** Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan.

.SG-SSA-371

COMPLETING, TESTING AND USING

The Musicolour II

Full circuit details for our new Musicolour audio light modulator unit were given in the December issue, together with most of the information describing its construction. In this article the author explains how to complete the unit, and then deals with troubleshooting possible faults and the choice of lighting displays.

by LEO SIMPSON

When mounting the transformers and L-shaped heatsinks for the Triacs, ensure that the board has been drilled correctly so that the attaching screws are well clear of the copper pattern. All screws should be fitted so that the nuts are on the component side of the board. It is a good idea to install lockwashers on all components mounted on the board, for reliability.

Having checked the board carefully for wiring errors, components may be installed in the chassis. Rubber feet are secured with a screw and nut, the nut being held in the foot itself. Potentiometer shafts should be cut to suit the knobs used. The mains cord is passed through a grommeted hole in the rear of the chassis and anchored by a clamp underneath the fuseholder. The active wire goes to the fuseholder while the neutral and earth wires are terminated on a three-way tagstrip, as shown in the wiring diagram. The earth wire connects to the "foot" terminal of the tagstrip, so that it is connected directly to chassis. When terminating the mains cord, the earth wire should be left with a loop of slack, as shown in the wiring diagram, so that if the cord is strained to the limit, the earth wire is the last to break.

Proper earthing of the chassis is the most essential step in the construction of the Musicolour. If it is not properly earthed a wiring mistake or component failure could make the chassis "live" and lethal!

Care is particularly necessary where the equipment is to be used in a public situation, in association with a public address system, musical instrument amplifiers, coloured spotlights, festoon lighting, etc. In these circumstances, the Musicolour unit itself should be checked by a qualified electrician, along with the lighting fixtures to be connected to it.

The holes in the chassis for the wires to the output sockets should be fitted with grommets to avoid chafing of the cable insulation. Note also that the wires to the output sockets should have the same current rating as the mains power cord, which itself should have a rating to suit a 2400W load.

Having installed all the mains wiring, the board may now be mounted. It is mounted using ⅛th inch screws and nuts, with two nuts used to space the board at least ¼-inch from the chassis. The connections from the board to the rest of the wiring may now be made. Note that neither side of the input wiring is connected to chassis, to avoid earth loop problems.

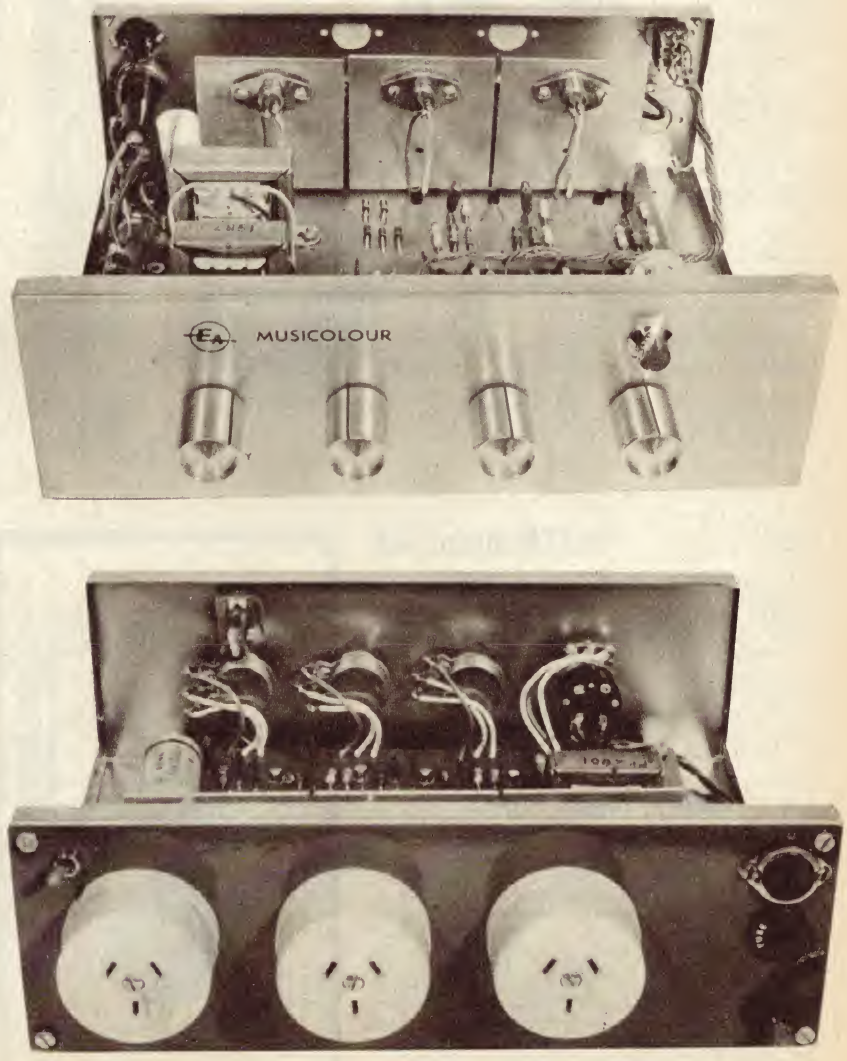
The pilot light is a neon bezel with a current limiting resistor incorporated. If a neon bezel without a limiting resistor is on hand a resistor of 150K should be connected in series with it. The neon bezel we used is moulded in red plastic. It is made by Telite and distributed by IRH Components Pty Ltd.

The standby switch used was a miniature type such as are available from Plessey or IRH Components Pty Ltd. It is a three-pole, double throw unit, used as a single-throw switch.

Before the unit is connected to the display lamps and power applied, several checks should be made. First and most important, check that there is a direct connection between the earth pin of the mains plug and the chassis. Also, check that there is high resistance (eg, several megohms) between the heatsinks of the Triacs and the neutral line of the mains. There should be high resistance between both sides of the mains and the chassis. These checks should be made with a multimeter.

In operation, it will be found that there is an optimum setting for sensitivity controls for the particular program in use. If the signal level is too high, the lamps will tend to glow continuously. If the signal level is too low, the lamps will be extinguished for most of the time. A little experimenting with controls will produce the most varied display for each program. It will also be noticed that the low channel is not as sensitive as the other two — this is quite normal and is mainly due to the characteristics of the input transformer.

Finally, if you are one of those unlucky readers whose Musicolour does not function, here are a few points on trouble-shooting. Remember, though, that this procedure can be

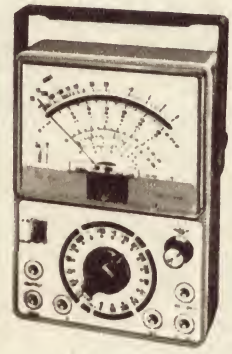


Two views of the Musicolour, showing rear chassis and Triac heatsink details.

In laboratory, workshop, or field... JAYEM are the ideal, accurate, economical multimeters

1 JAYEM Model 20K

17 Ranges: DC Voltage—0-5, 25, 100, 500, 1000; AC Voltage—0-10, 50, 250, 1000; DC Current—0-50μA, 250mA; Resistance—0-20K, 2mΩ (centre scale 260); Decibels—-5 to +62 (in 4 ranges) • **Accuracy:** ±3%, DC Voltage and Current; ±4%, AC Voltage • **Sensitivity:** 20,000 ohms/volt DC; 10,000 ohms/volt AC • **Meter Movement:** 3", 50μa full scale • **Battery:** Requires one, type AA penlight cell for ohms function • **Size:** 1-15/16" x 3-1/2" x 5-1/16". **$13.00** plus Sales Tax



2 JAYEM Model 100K

51 Ranges: DC Voltage—0-0.3, 0.6, 1.2, 1.5, 3, 6, 12, 30, 60, 120, 300, 600, 1200; AC Voltage—0-1.5, 3, 6, 12, 30, 60, 150, 300, 600, 1200; DC Current—0-15, 30μA, 3, 6, 30, 60, 150, 300 mA, 6, 12 A; Resistance—0-2K, 200K, 2mΩ, 20mΩ (centre scale 20); Decibels—-20 to plus 63 in 6 ranges; Output—0-1.5, 3, 6, 12, 30, 60, 150, 300 volts • **Accuracy:** ±3% full scale, DC voltage and current; ±4% full scale, AC Voltage • **Sensitivity:** 100,000 ohms/volt DC (50,000 in VA/2 position); 10,000 ohms/volt AC (5,000 in VA/2 position); DC circuit sensitivity = 15μA, 300mV • **Meter Movement:** 5" meter, 9μA full scale • **Batteries:** Requires two type C cells for ohms function • **Size:** 2¾" x 5¼" x 7½". **$35.00** plus Sales Tax

3 JAYEM Model 30K

22 Ranges: DC Voltage—0-6, 30, 60, 300, 600, 1200; AC Voltage—0-12, 60, 120, 600, 1200; DC Current—0-60μA, 30mA, 300mA; Resistance—0-2K, 200K, 2mΩ (centre scale 36); Decibels—-10 to +63 (in 5 ranges) • **Accuracy:** ±3%, DC Voltage and Current; ±4%, AC Voltage • **Sensitivity:** 30,000 ohms/volt DC; 15,000 ohms/volt AC • **Meter Movement:** 3½", 27μA full scale • **Battery:** Requires one, type AA Penlight cell for ohms function • **Size:** 2" x 5½" x 3-1/16". **$19.50** plus Sales Tax

4 JAYEM Model 50K (not illustrated)

43 Ranges: DC Voltage—0-0.3, 0.6, 1.5, 3, 6, 12, 30, 60, 150, 300, 600, 1200; AC Voltage—0-3, 6, 15, 30, 60, 120, 300, 600, 1200; DC Current—0-30, 60μA, 1.5, 3, 15, 30, 150, 300mA, 6, 12A; Resistance—0-3K, 300K, 3mΩ, 30mΩ (centre scale 15); Decibels—-10 to +17 db; Output—0-3, 6, 15, 30, 60, 120, 300 volts • **Accuracy:** ±3% full scale, DC voltage and current; ±4% full scale, AC voltage • **Sensitivity:** 50,000 ohms/volt DC (25,000 in VA/2 position); 5,000 ohms/volt AC (2,500 in VA/2 position); DC/circuit sensitivity = 30μA, 120mV • **Meter Movement:** 4" meter, 20μA full scale • **Batteries:** Requires three type AA penlight cells for ohms function • **Size:** 2-¼" x 4" x 6". **$25.00** plus Sales Tax

Distributed by:

JACOBY MITCHELL

SYDNEY	26 2651
MELBOURNE	30 2491
ADELAIDE	53 6117
BRISBANE	44 4674
PERTH	28 8102
LAUNCESTON	2 5322

MAIL THIS COUPON TODAY

Jacoby, Mitchell & Co. Pty. Ltd.,
P.O. Box 2009 North Parramatta 2151
Please send me details of Jayem Multimeters (place circle round applicable square)

1 2 3 4

NAME .....

ADDRESS .....

..... POSTCODE .....

extremely hazardous because the full mains voltage is present in the circuit. If you do not have a multimeter and/or do not feel confident about your ability to cure a fault in the device, leave it strictly alone. Take it, along with this article, to a competent serviceman.

Trouble-shooting can be made less hazardous if the mains active and neutral lines are exactly as shown in the circuit diagram, ie, with the common line of the circuitry tied to the neutral line. This can be verified with a multimeter: Measure the voltage, with multimeter switched to a high AC range, between the negative terminal of the 1000uF capacitor and chassis. If it is zero, okay. If it is 240 volts, swap the active and neutral leads on fuseholder and tagstrip. Remember though, that while most of the circuitry is now at chassis potential, the full mains voltage is applied to the neon pilot lamp, to the power switch terminals, to the fuseholder and if a load is connected, to the three Triac heatsinks.

Trouble-shooting should begin by ensuring that there are no wiring mistakes or incorrectly connected components. If not start with the Triacs. First, with no audio signal applied, switch the standby switch to either of its positions. In one position, all lamps should be at full brilliance; in the other, extinguished. If a lamp is alight in both conditions short the gate of the appropriate Triac to its A1 terminal; if the lamp is still alight, the Triac is faulty.

If the lamp stays extinguished in both positions of the Standby switch, the Triac or PUT may be faulty. The Triac may be tested by disconnecting the gate electrode and connecting a 1K resistor between A2 of the Triac and gate; the lamp should light. If not the Triac is faulty. If the lamp does light, the Triac is okay and the PUT stage is malfunctioning.

With the standby switch set for the Modulation mode, audio signal applied and sensitivity controls suitably adjusted, all lamps should be capable of being modulated. If not, the FETs can be checked for faults. If a lamp is partially alight with no signal applied, a cure may be effected by reducing the 390-ohm resistor. If the lamp will not light with signal applied, the FET may be short circuited. This can be checked by connecting a 9V battery across the 2.2M resistor, negative to gate. The lamp should light; if not, the FET is faulty.

If the FET is okay and the lamp still does not light, the diodes in the voltage-doubler network should be checked, in situ, with an ohmmeter. They should be about 300 ohms in the forward direction and several megohms in the reverse direction. If they are leaky, replace. Each of the filter stages can be checked for correct operation by measuring the voltage at the emitter of each transistor. This should be within 1 volt of half the supply voltage (ie, about 9V). DC voltages should be measured with respect to the negative terminal of the 1000uF capacitor. An operational transistor will have 0.6 volts drop from base to emitter. The preamplifier stage can be checked in a similar manner — ie, 9V at emitter of Tr2.

These checks will not find every fault but they should at least identify the stage where a fault is occurring. Again, remember that mains voltage is applied to the circuit, so absolute care is essential when working on the unit.

As noted previously, the possibilities for displays are endless and are limited only by the reader's imagination. The ideas outlined here are only a guide and we will be interested to hear from readers who have thought up other ideas.

Most of the displays can be built around 25-watt or 40-watt coloured globes. These are available from Philips and other manufactures in colours such as red, yellow, green and blue. It is interesting to note that the blue lamp will not appear nearly as bright as the red and yellow types. This is because the eye is less

Coloured Comptalux lamps project a fine display on to walls and ceilings.

sensitive to the blue end of the spectrum, and tungsten filaments emit most of their light in the red and yellow region of the spectrum. This means that a blue filter stops most of the light. In general then, the power needed for the blue lamps will be two or three times that needed for red and yellow lamps.

The displays should be arranged so that the lamps are not viewed directly. Looking directly at bright lights is tiring, to say the least. The basic materials needed to make interesting patterns are crinkled aluminium foil and frosted, fluted or patterned glass.

The simplest possible display is to mount three or more coloured lamps on a board and place them behind a stereo system cabinet so that they light the wall behind it. We suggest red for the low channel, green for the medium channel and blue for the high channel.

Another idea is to mount a number of lamps in a row along a board, place frosted glass in front of them and mount the whole display on top of the stereogram, organ or in the particular "interest point" in the room. Lights can be placed inside a cabinet, with crinkled aluminium foil behind them, and frosted glass in front. The result is a portable, completely enclosed display.

One of the most obvious tricks would be to modulate strings of "Christmas tree" lights. These could be strung around the house for the most novel Christmas decorations in your district.

For higher power displays, on stage for musical groups or in discotheques, coloured spotlights will be required. While you can buy your own spotlights and use gelatin filters to colour them to taste, coloured spotlights are marketed by Philips Electrical Pty Limited and available from many trade houses which specialise in lighting. The lamps are in the Philips Comptalux range and are available in red, yellow, green and blue. The remarks we made above about the brightness of different colours still hold for these lamps.

Many interesting displays could be obtained with these spot lamps aimed against walls, using beam splitting mirrors and rotating mirror balls. As we stated before, your imagination is the only limit.

FORUM

Conducted by Neville Williams

Tariff: controversial but not simple

Life would be so much simpler if other people didn't insist on upsetting our notions with contrary ideas and information. For example, take the matter of tariff or import duty on electronic components. It's a fairly simple matter — provided you don't look beyond your own immediate needs!

The matter of tariff on electronic components has popped up again and again in conversation since we raised it in connection with amateur band transceivers in the December 1970 issue. It was followed up in the April issue and again in July and September, and received honourable mention in the Federal Parliament on September 30.

We expressed the conviction that operators of amateur radio stations in Australia were being seriously disadvantaged by the imposition of tariff on imported amateur band transceivers. It was one of the factors which were eroding the amateur movement in this country and sacrificing a skill which is of both civic and national significance.

We maintained that, numerically, the market was small and the amount of tariff involved quite insignificant — to the Government. It was also unlikely to support an efficient local manufacturing effort, so what were we trying to protect?

We see no reason to change the views that we have expressed. The amateur movement does need a shot in the arm (editorial, July issue) if it is not to wilt in the face of other competition for the attentions of would-be participants.

Some have argued that the present cost of transceivers in Australia is not radically different, relative to salary levels, to the cost in certain other countries. This may or may not be so but the motivation towards amateur radio and the competition for time and money certainly is different. And amateur radio is losing out as a result.

Some relief from the situation was in sight part way through last year but the proposed concession was withdrawn on representations from Australian Consolidated Industries Ltd and Wagner Industries Pty Ltd, both of whom stated their intention to market a locally-produced transceiver.

The intervention of the two companies was the subject of a question in Parliament on September 30. Senator Wriedt did his duty by asking a series of questions and Senator Cotton did likewise by answering them. It had the air of a formal Parliamentary exercise which left the amateurs exactly where they were — facing a price tag far in excess of what many are prepared to pay and with a vague reference to something in the future that might be less prohibitive but still too much!

So the Government does nothing, the amateur gets nothing and the two firms concerned are left in the role as the villians of the piece.

All very simple and straightforward — if we could leave the matter there!

But really we can't . . . or we shouldn't.

Why are the locally produced transceivers so expensive?

Well, partly because they have to be aimed at the widest possible market: professional, commercial, military perhaps, export perhaps. As a result, they are over-designed relative to the needs of budget-minded amateur operators, and, widest possible market notwithstanding, the manufacturers have to face the problem of amortising substantial development costs over all too few units, with the obvious result.

However, what tends to be overlooked is another very significant plus factor in the manufacturer's costs — what they have had to pay for the "privilege" of using locally made components or importing those which have to come from overseas.

In such a transceiver, there is quite a poultice of small components: resistors, capacitors, diodes, transistors and so on. Most of them can be obtained from local manufacturers — but at a price which is way above what manufacturers in certain other countries can buy them for. The difference shows up in the end price.

The same inexpensive components can be imported into Australia but, in crossing the customs barrier, they attract a tariff of so many percent, or of such-and-such a flat figure, whichever is the greater. As a result, and by obvious design, they end up as being little more than competitive with the locally produced item.

The same kind of loading goes on to many components which do not warrant manufacture in this country so that, by the time all the costs are met, the local product may run out at about twice the cost of the imported item.

This leads to an interesting proposition:

If the amateur movement is to be fostered by relaxing the tariff on complete transceivers, local manufacturers can logically claim the right to compete by offering transceivers built around tariff-free components!

But what a precedent this would set and how many other consumer groups would come forward to claim the same consideration as amateurs.

And what problems of administration it would pose to ensure that tariff-free components found their way only into tariff-free projects. The situation would be sufficient to blanch the face of any self-respecting public servant!

To give point to the argument, if Australian-made apparatus is exported it is possible, in certain circumstances, to reclaim the tariff paid on imported components used in its construction. This naturally comes off the selling price.

As a result, it is feasible for a piece of locally-made equipment to be exported and sold overseas more cheaply than in Australia itself. It may even be competitive outside Australia with equipment manufactured in foreign countries!

Weird?

On the surface it is — but let's follow the theme through to see where it leads.

From HANSARD

RADIO TRANSCEIVERS

(Question No. 1383)

Senator WRIEDT asked the Minister representing the Minister for Customs and Excise, upon notice:

(1) Have tariff restrictions been imposed on the importation of radio transceivers used by amateur operators.

(2) Did Wagner Industries Pty Ltd and Australian Consolidated Industries Ltd both claim they could market suitable transceivers at prices competitive with those of imported models, and are they currently selling 100 watt models for $1,340 and 500 watt models for $2,320, whereas the similar Japanese-made models would be available at $400 and $500 respectively.

(3) How do the abnormal differentials in the prices of these transceivers justify the total exclusion of the Japanese models from the Australian market.

Senator COTTON — The Minister for Customs and Excise has provided the following answer to the honourable senator's question:

(1) No. Radio transceivers used by amateur operators were previously admitted at concessional rates of duty under by-law. Consequent upon the manufacture in Australia of transceivers suitable for use by amateur operators concessional admission under by-law is no longer appropriate and imports are now subject to the duties imposed by the Parliament.

(2) Australian Consolidated Industries Ltd market a 400 watt 6 band transceiver which is designed to meet the requirements of amateur operators. It is understood that this transceiver retails for approximately $650, inclusive of sales tax, or the transceiver can be supplied without a digital readout thus reducing the price by $150.

Wagner Industries Pty Ltd manufacture transceivers designed for commercial use, but which can be modified for amateur use. It is understood that, this company markets a 100 watt transceiver suitable for amateur use which retails for $783.

(3) There is no exclusion of the Japanese models from the Australian market. Imports from that country would be liable to duty at 45 per cent ad valorem.

If the prime objective was to obtain the cheapest possible built-up equipment for Australian designers and assemblers, the obvious approach would be to admit all small components duty-free.

The effect on prices could be sensational, but are we prepared to live with the implications?

A few weeks ago, a large resistor manufacturing plant in Sydney was shut down because it could not economically compete with imported resistors, tariff notwithstanding. Because unused plant cannot be allowed to occupy valuable premises and gradually lose its value through obsolescence, it will doubtless be sold off and shipped to some foreign country, where labour costs are lower.

I, for one, regret that such a step has become necessary. Perhaps it's an emotional reaction but I just regret it!

If the tariff was removed from all small components, it is fairly safe to say that the same thing would happen to every component facility in the country.

To be sure, we could build up lots of cheaper equipment for domestic and overseas consumption. Technology at this level might flourish but the facility and the know-how to produce resistors, capacitors, transistors, integrated circuits and a variety of other small but sophisticated components would be lost within a few years.

I doubt that too many readers would support such a proposition. Yet it is surely implicit in the elimination of the tariff on components.

To go one step further, the elimination of tariff on built-up equipment as well, would release a flood of electrical and electronic consumer goods into the country at prices well below those to which we are accustomed.

It would also very rapidly shut the doors of most of our electrical and electronic factories.

So we are faced with certain broad choices:

- Artificially sustained prices and limited export opportunities, in order to maintain a reasonable level of technical resource and expertise — as at present.
- Somewhat reduced prices, improved export opportunities but minimal facility and expertise at the component level.
- Cheap consumer goods, no export opportunity, no technical expertise.

Even at this point, the alternatives bristle with compromises variously desirable or unacceptable to individual groups.

But the matter cannot be confined to the electronics industry and its customers.

At a national level, it becomes just a part of a whole array of problems ranging from defence capabilities to balance of payments and import/export arrangements with Australia's trading partners.

If this begins to look like a verbal smoke screen, it is not meant to be.

It is simply to put this whole matter of tariff on electronic equipment into perspective. It is a thorny, complicated segment of a thorny, complicated whole.

Such are the overtones to the "simple" matter of tariff on amateur band transceivers!

The Pi-Coupler

Although widely used for such purposes as output matching in radio transmitters, the pi-section coupling network still remains something of a mystery to many radio amateurs and technicians. This article explains how it works, and also gives the basic design procedure.

by JAMIESON ROWE

Probably a majority of modern transmitters and transceivers designed for use on the HF and lower VHF amateur bands employ a pi-section coupling network or "pi-coupler" to perform both output tuning and impedance matching between the power amplifier or "PA" stage and the aerial feeder cable. It is also used for the same purpose in many transmitters designed for other applications, and in industrial and medical equipment such as induction heaters and diathermy units.

In view of the widespread use of the pi-coupler, it is surely disappointing that the established radio textbooks and amateur radio reference manuals generally devote very little space to a discussion of its basic operation. Most simply give its basic circuit configuration, as in figure 1, together with a few basic formulae describing its properties. Small wonder that to many radio amateurs and technicians its operation is still something of a mystery!

The writer will try to dispel some of this mystery in the present article. The aim will be to show that as far as basic operation is concerned, the pi-coupler may be considered as virtually only a conventional parallel-tuned resonant "tank" circuit with a tapping system for impedance matching. The only difference is that it is rearranged into an unfamiliar form.

To begin, then. As figure 1 shows, the basic pi-coupler consists of a series inductor L, together with two shunt capacitors C1 and C2. Usually both C1 and C2 are made variable, as shown. The load resistance Ra presented by the aerial feeder cable is connected to the network across C2, while the plate or collector of the PA stage connects across C1 via a high-value DC blocking capacitor. An RF choke is used for the PA stage DC return.

It is possible to simplify the circuit of figure 1 by reducing it to the bare essentials as far as its RF operation is concerned. This is shown in figure 2(a), which also represents the way that the pi-coupler transforms the actual load resistance Ra into an effective load Rp suitable for the PA stage. Unfortunately the circuit of figure 2(a) still gives little clue as to the way in which the network operates.

As it happens, all that is necessary to make the operation more easily seen is to redraw the circuit with the various elements of the network juggled around a little. By drawing the symbol for L vertically, and tying the earthed ends of C1 and C2 together, we end up with the circuit of figure 2(b). Now it may be seen that C1 and C2 are really connected in series across L, forming a parallel resonant circuit which is quite normal apart from the minor detail that neither side of the inductor is earthed. Instead the circuit is earthed at the junction of the two series capacitors forming its "C" arm.

It should perhaps be noted in passing that although this re-arrangement of the pi-coupler network can be justified, on the grounds that it should help the reader to understand its operation as a resonant tank circuit and as an impedance matching device, it politely ignores the fact that the network also functions very effectively as an attenuator of signal harmonics. As a glance at figure 2(a) reveals, it does this by virtue of the fact that its configuration is the same as that of a pi-section filter, so that at frequencies above resonance its transmission falls away very rapidly. But this aspect of pi-coupler performance is fairly straightforward, and need not concern us further here.

When drawn as in figure 2(b), the action of the pi-coupler as an output tuned circuit is easily seen. Because the load Ra and the output of the PA stage are both coupled to the resonant circuit formed by C1, C2 and L, the circuit resonance is able to play a major part in determining the frequency components transferred from one to the other. But the reader may still not find it easy to see how the circuit is able to transform the load resistance Ra into the effective load Rp.

The clue to this aspect of pi-coupler operation is the fact that the load Ra and the PA stage are each connected across only a part of the capacitive arm of the resonant circuit: Ra across C2, and the PA stage across C1. The fact is that this series combination of C1 and C2 forms an impedance-transforming reactive divider. The junction of the two provides a low impedance "tap" into the resonant circuit.

Probably the reader will be more familiar with the tapped inductor method of transforming impedance, as shown in figure 3(a). This method is frequently used where a relatively low impedance circuit has to be coupled into the resonant circuit without causing it undue disturbance or damping its resonance behaviour. The position of the tap on the inductor is chosen to provide the desired impedance step-up ratio. The lower the position of the tap, the greater the extent to which the impedance of the circuit connected to the terminals is stepped up, as far as the resonant circuit is concerned.

Thus if the inductor is tapped in the ratio of "N" turns to "M" turns, and the external circuit of resistance R is connected across the portion having "N" turns, then its effect will be the same as that of the much larger resistance Rd connected right across the resonant circuit. The size of Rd is related to R by the square of the appropriate turns ratio:

$$Rd = R.((M + N)/N)^2 \qquad \ldots(1)$$

As it happens, virtually the same impedance step-up effect may be obtained by tapping the capacitive arm of the resonant circuit, instead

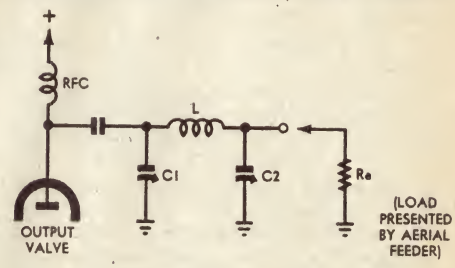


Figure 1: The basic pi-coupler circuit configuration.

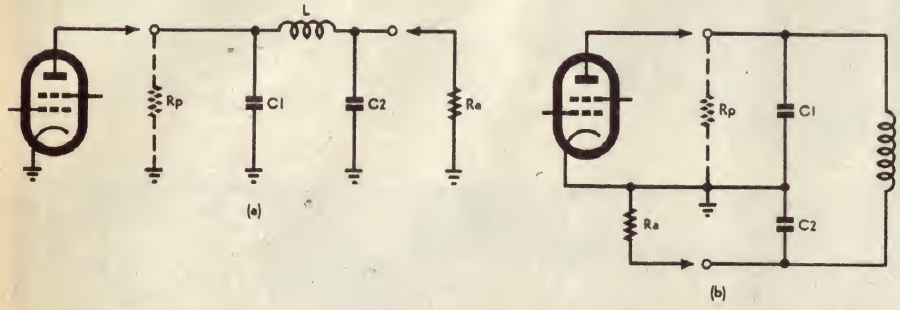


Figure 2: Even reducing the network to its RF essentials as in (a) gives little insight into its impedance transforming behaviour. But rearranging the elements as in (b) reveals that it is basically a tapped tuned circuit.

of the inductive arm. Naturally it is not an easy matter to connect a "tap" into a single capacitor. However from basic circuit theory the same effect may be achieved quite simply, by using two capacitors in series. The junction of the two then becomes the "tap", with the impedance step-up ratio determined by the value of the two capacitors.

It turns out that the impedance transforming ratio obtained with the capacitive divider system follows a similar "squares" relationship to that obtained with the inductive divider. Thus in figure 3(b), the effective resistance Rd connected across the resonant circuit is related to the actual resistance R connected across the terminals by the equation:

$$Rd = R.((Xc1 + Xc2)/Xc2)^2 \qquad \ldots(2)$$

This impedance-transforming action of the

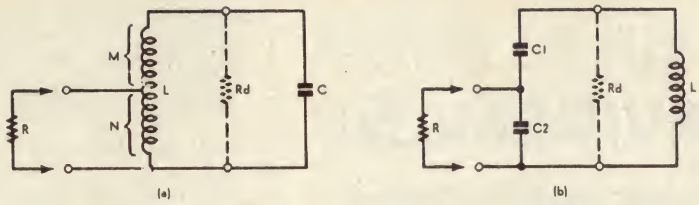


Figure 3: A comparison of the (a) inductive, and (b) capacitive tapping methods.

capacitive divider works in both directions. It can step down impedance as well as stepping it up. Thus if an actual resistance Rd were to be connected right across the inductor L in figure 3(b), instead of a resistance R across the terminals, then the action of the capacitive divider would be such that a circuit connected to the terminals would "see" an effective input resistance of value R. In other words we can quite validly rearrange equation (2) to read:

$$R = Rd.(Xc2/(Xcl + Xc2))^2 \quad \ldots(3)$$

If the circuit were to be connected instead across the upper capacitor C1, while the resistance Rd were still connected across L, it would also see a resistance lower than Rd. But in this case the value seen would be given by the equation:

$$Rp = Rd.(Xcl/(Xcl + Xc2))^2 \quad \ldots(4)$$

As many readers may have guessed by now, the capacitive divider can in fact be used to perform both the step-up and step-down operations at the same time. This follows because if a circuit of resistance R is connected across C2 of figure 3(b), not only does an effective resistance of value Rp appears across capacitor C1.

This is precisely how the pi-coupler performs its impedance matching function. It uses the capacitive divider first to step up the low resistance load presented by the aerial feeder, and then again to step it down to a value suitable as a load for the PA stage. The diagrams of figure 4 should help make this clear. It may be seen that the final matching ratio between the actual load Ra and the transformed load Rp is simply given by the square of the ratio between Xcl and Xc2:

$$Rp = Ra.(Xcl/Xc2)^2 \quad \ldots(5)$$

Like any other resonant "tank" circuit used at the output of a transmitter, the pi-coupler must be designed to have a Q which is sufficiently high to attenuate undesired harmonics, yet low enough to ensure that an adequate proportion of the RF energy stored in the tuned circuit is transferred to the load. With most transmitters designed for telephony, a good compromise between these factors is achieved with a Q of around 10-12.

The operating Q of the pi-coupler is essentially the ratio between Rd, the effective damping resistance across the total resonant circuit, and the reactance of either L or the total effective capacitance at the operating frequency. Thus if Rd were known, it would be possible to calculate the inductive reactance X1, by giving Q a value of say 10. And this would allow one to calculate the required value of L knowing the operating frequency.

As it happens, one does not usually know Rd when commencing the design of a pi-coupler. But it is generally possible to arrive at a fairly close estimate of Rp, the transformed load resistance, either from the valve manufacturer's literature, or from past experience. Therefore in order to calculate X1 and L one must substitute for Rd in the basic expression for Q, using expression (4). This gives the following equation:

$$X1 = (Rp/Q).((Xcl + Xc2)/Xcl)^2 \quad \ldots(6)$$

Happily this slightly formidable equation can be simplified quite considerably whenever the pi-coupler is used to give a fairly high impedance transformation between Ra and Rp. And this is generally the case with radio transmitters, or at least those having a valve in the PA stage: Ra is usually either 50 or 75 ohms, while Rp is usually 1K or greater.

With such a high transformation ratio, capacitor C2 becomes so large compared with C1 that its reactance plays a negligible part in determining the total capacitive reactance and the working Q. The squared capacitive reactance ratio in equation (6) becomes so close to unity that it may be ignored, simplifying the relationship to:

$$X1 = Rp/Q \quad \ldots(7)$$

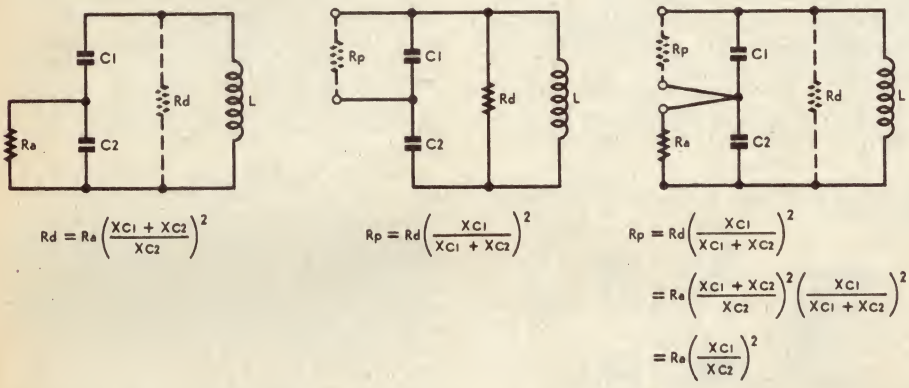


Figure 4: The impedance transforming action of the network can be seen more readily if it is broken down into these stages.

In practice the first step in designing a pi-coupler is therefore a fairly simple one: with a suitable value for the desired PA stage load Rp, and Q = 10, use equation (7) to find X1. Then find the corresponding value of L using the familiar expression for inductive reactance, knowing the operating frequency.

It remains then to work out the values for C1 and C2, knowing that these must satisfy two requirements. In series they must resonate with L at the operating frequency, while at the same time they must provide the required transformation ratio to provide the desired Rp.

The second of these requirements will of course be met if the ratio between the two capacitors is such to satisfy equation (5). However to satisfy the first requirement they must also be able to satisfy the equation:

$$Fo = 1/2\pi\sqrt{L.C1.C2/(C1 + C2)} \quad \ldots(8)$$

This is simply the familiar equation for resonant frequency modified by substituting the equivalent series capacitance of C1 and C2.

Happily when the pi-coupler is used to give a fairly high impedance transformation ratio, this equation can again be simplified. As before, the relatively large value of C2 compared with C1 means that C2 plays a minor part in determining the resonant frequency. Hence equation (8) simplifies to:

$$Fo = 1/2\pi\sqrt{L.C1} \quad \ldots(9)$$

In other words, one can neglect C2 and assume that only C1 resonates L at the operating frequency. This means that having found L, it is an easy matter to work out the value of C1.

And with C1 found, equation (5) may be used to find out the corresponding value of Xc2 and hence C2, knowing Rp and the actual load resistance Ra presented by the aerial feeder (50 or 75 ohms).

Although these design calculations will give specific values for L, C1 and C2, it should be remembered that one rarely has a very precise knowledge of the optimum PA stage load resistance Rp. This combined with the various simplifying assumptions used to arrive at equations (7) and (9) means that it is usually desirable to use variable capacitors for both C1 and C2, as shown in figure 1.

It should also be remembered that the output capacitance of the PA stage is effectively a part of C1. As the output capacitance is composed at least partly of strays, this is a further reason for making C1 a variable.

A variable capacitor for C2 also allows the coupler to be adjusted to cope with a load of other than the nominal 50 or 75 ohms design figure, as would in practice be presented to the transmitter when the aerial is not perfectly matched to the feeder. In other words, it allows the transmitter to be adjusted to cope with a range in loading and SWR situations.

It should be noted that the simplified equations (7) and (9) are not really applicable when designing a pi-coupler for use with a transmitter having a transistor in the PA stage. This is because the optimum load Rp for a transistor PA is generally much lower than for a valve. With high power transistor PA stages the required value of Rp may in fact be very much lower than Ra.

In such cases the pi-coupler is generally not the most appropriate coupling network to use, as other networks involve fewer design trade-offs. However if the reader seeks to try out a pi-coupler, it should at least be borne in mind that the full equations (6) and (8) must be used in the design calculations.

Although this discussion of the basic operation and design of the pi-coupler has been rather brief, the author hopes that it will be found helpful.

Somebody Else's Problems

This month I am presenting several stories sent to me by a fellow serviceman. As well as having an air of novelty, the stories make refreshing reading, simply because they come from a different person, working in a quite different environment.

He runs his own business in what might fairly be called a large country town in north Queensland. I have never met the gentleman, but we were put in touch by a mutual aquaintance.

He sent me his stories on tape and I confess I found his descriptions quite fascinating. He has a habit of digressing in the middle of a story to recall a previous case having some similarity; or to comment on some local identity; or offer his opinion on the set, its maker, or its previous serviceman.

Perhaps this is against all the rules of story telling, but it had the effect, at least as far as I was concerned, of building up a quite vivid picture of the man and the environment in which he works. Not to mention some nostalgia for life in a country town. Here are some of these impressions.

He is not the only serviceman in the town, and he also faces competition from nearby towns. Some of these organisations are more concerned with sales than service, and what service they do provide is mainly by "valve jockeys"; a race for which he has an ill-disguised contempt.

He believes, almost passionately, that a serviceman has an obligation to do the best possible job for his customer; that a fault cannot be regarded as cured until the exact cause has been proven beyond all doubt; that he should keep a set going as long as it is economically possible to do so.

He speaks disparagingly of valve jockeys who service the same sets on an average of six times a year, and of how these sets, when they were finally brought to him and completely overhauled, have run for 18 months or two years with no sign of trouble — and are still running.

He has some nasty things to say about set manufacturers too. About some of the "bombs" they turned out in the past, about some of their doubtful designs which either contribute to service calls, or make them unnecessarily difficult to carry out.

He even claims to be off-side with some manufacturers because he keeps sets going too long, instead of recommending a trade-in on a new set. Yet this is something he stubbornly refuses to do while ever he honestly believes that the set is worth repairing.

At the same time, he is no starry-eyed perfectionist, due to go broke because his ideals override sound business principles. On the contrary, he obviously has a thriving business, with customers beating a path to his door, seeking service satisfaction after being disillusioned by other service organisations.

I'm sure there's a moral here somewhere!

Anyway, to get down to his stories. As I hinted earlier, he makes no pretence of being a professional story teller, so I have taken his stories, digested them, and written them in a style in which I think he would have liked to have presented them himself.

The first story concerns a TV set which, for some time, had been suffering from sudden blacking out of the screen, apparently due to horizontal oscillator failure or some similar condition.

The fault was intermittent, and at times the set would behave quite normally. The customer also complained that a severe horizontal shaking or a multiple ghosting effect would be present at times. Changing channels would sometimes set things off.

"Er . . . Brace yourself, Mr. Higgins . . . that little tube you figured you'd need measures 23 inches."

("PF Reporter")

Initially, quite exhaustive tests proved inconclusive. However, it was established that the horizontal oscillator, the pentode section of a 6BL8, was not dropping out of oscillation completely, but was operating at a greatly reduced level. This condition could be brought on or removed by touching various parts of the oscillator circuit with the metal blade of a small insulated screwdriver.

A short length of tinned copper wire, connecting the central shield of the 6BL8 valve socket to chassis, turned out to be particularly touchy. If touched with a metal screwdriver blade, about one third of its length from the chassis end, the faulty condition would disappear.

The real cause of the trouble was finally determined with the aid of an oscilloscope and current meters in the grid circuit of the oscillator valve, and the 6CM5 line output valve. With this set-up, the following conditions were observed when the fault was present.

(1) Drive to the grid of the 6CM5 was greatly reduced, as indicated by both the oscilloscope and grid current meter.

(2) The meter in the grid circuit of the 6BL8 horizontal oscillator stage showed a marked INCREASE in grid current.

(3) Oscilloscope tests showed that this increase in grid current was not due to any increase in oscillator activity at line frequency. On the contrary, the waveform at line frequency was also at a reduced level.

From all these observations it was deduced that the 6BL8 was oscillating in a spurious mode as well as its intended mode; almost certainly at some very high frequency. This was generating excessive grid bias, thus upsetting the operating conditions of the 6BL8, and preventing it from functioning correctly at line frequency.

Replacing various critical components around the oscillator circuit failed to cure the fault. The only effective cure was found to be a 3.9K stopper resistor in the 6BL8 grid circuit. This was completely effective.

This stopper is featured in a number of other brands of receiver using similar circuitry and, in fact, it was from such a circuit that the idea was taken.

Just why the makers of this set chose to ignore what is regarded as a standard precaution by most other manufacturers, is not clear. Nor is it known how many other sets have suffered from this fault, or how successfully they have been dealt with by other servicemen, particularly the "valve jockey" types.

A number of ideas were investigated to try to explain the mechanism by which the spurious oscillations were taking place. The most likely theory appears to be that the pentode section of the 6BL8, and its associated triode section, which normally functions as an AFC valve, were operating as a form of multivibrator.

More precisely, it is suggested that the central shield in the valve socket was not effectively at chassis potential at very high frequencies. This, in turn, was due to the length of wire which was supposed to do the job but which, at these frequencies, would function more like an inductor. Add to this situation the stray capacitance between plate and grid pins of the socket and it is quite possible that the set-up could function as a multivibrator at these frequencies.

The next story concerns a well known brand of TV set, vintage 1962, which the writer had sold to the customer and subsequently serviced throughout its life. It had required about average servicing but, with the benefit of hindsight, it is now obvious that it had suffered from an intermittent fault from the day it was made.

The most commmon complaint had been picture weave; the hula girl effect which results from hum finding its way into the line timebase. In all cases the effect had been observed on the bench and the fault traced to one of the fairly obvious and conventional faults which produce this effect. Thus, at various times I had replaced

the final filter capacitor, the voltage doubling capacitors, critical components in the sync circuit, and so on. And, on each occasion the weave, originally quite bad, had seemingly responded to the appropriate treatment.

Finally, the owner brought it in and asked for a complete overhaul. There were a number of minor things wrong with it, most of which appeared to need only routine treatment. But the picture weave was still bothering him. Sometimes it seemed to vanish for no apparent reason, then would return just as mysteriously. He admitted that it wasn't really bad; not as bad as on the previous occasions when he had complained, but the truth was that he now realised that it had always been present to about this extent, but on a "here-today-gone-tomorrow" basis.

I can only assume that on those previous occasions when the set had been overhauled, the fault had elected not to show itself, thus creating the impression that there was only one source of the trouble, which had been fixed.

So this was the moment of truth. If I didn't solve the problem to my own satisfaction this time I might as well admit defeat. I just couldn't bring myself to send the set back to the customer unless I was one hundred percent certain that this fault had been fixed.

Fortunately, the fault elected to show itself on this occasion, so I checked all the usual causes of weave such as filter capacitors, by-pass capacitors, etc., without result.

Finally I brought the CRO into operation and began checking waveforms.

This did not reveal very much until I came to the cathode of the 6CM5 line output valve. In this make of set, the cathode returns to chassis through a 1 ohm resistor, the junction of the cathode and the resistor providing a check point at which the waveform can be monitored.

Connecting the CRO across this resistor, ie, between cathode and chassis, revealed the presence of a 50Hz signal superimposed on the deflection pulses. There seemed little doubt that this was the cause, even though its exact source had yet to be determined.

Closer investigation showed that the 1 ohm cathode resistor, the grid resistor, and one of the heater pins were all connected to chassis at the same point. This was a lug which had been punched and bent up out of the chassis when the latter was made — a technique which this manufacturer has used for as long as I can remember.

It is a good idea in many ways, but it has one drawback. Unless the operator who makes the chassis connections is able to apply plenty of heat, and is adequately skilled, it is very easy to produce a dry joint. Which was just what had happened in this case.

The result would be a certain amount of resistance in the heater circuit, across which a 50Hz voltage would be developed. This voltage would be applied between the cathode and the grid of the 6CM5. Connection to the cathode would be via the 1 ohm resistor, and to the grid via the previous stage (line oscillator), one side of the latter's output circuit being at chassis potential. The overall impedance of this stage would be relatively low, compared with that of the 6CM5 grid circuit.

So that was the solution to the intermittent weave problem; a dry joint which had managed to remain undetected for over eight years.

Next, I'd like to make a few comments about video detector diodes. These can cause some tricky faults, likely to result, initially, in a wrong diagnosis, because they do not all fail in the same way.

In one case I remember the set suffered from loss of contrast and poor sync, the latter being dependent on quite critical setting of the fine tuning control. This led me to suspect, initially, that the tuner was at fault, although I was able to discard this theory almost immediately.

Next, I considered the AGC system, since faults here can often cause poor sync by clipping off the sync pulses. Since it was easy to do, I first replaced the 6BU8 AGC valve, but the effect of this was to make the situation much worse. Apparently the old valve was on the way out and it was only the reduced AGC action which was allowing the sync system to work at all. Only by backing the AGC control right off could stable operation be obtained with the new valve.

This situation, together with lack of contrast, finally put me on the right track. I checked the video detector diode (OA90) and found that it measured 200 ohms in the forward direction and 230 ohms in the reverse direction. To make matters worse, it appeared that the reverse resistance was not constant.

Judging by the customer's comments about how the set had been behaving, it seemed fairly obvious that the diode had been behaving in this manner for quite some time. How much easier it would have been, had the thing simply failed completely.

The next story is also about diodes, but the final solution was not nearly so easy. The set was a three-in-one combination which had been taken to an opposition organisation with the complaint that there was buzz in the sound. Apparently the firm found the going a bit tough on this one, because they fobbed the customer off and generally mucked about for something like six months. Eventually the customer demanded that the set be returned, fixed or not.

This was done, together with a bill for $50.00, even though the sound buzz was as bad as ever. At this point, the owner brought the set to me.

I gave the thing a complete overhaul, found a lot of things wrong and fixed them, including most of the sound buzz. The one remaining fault was lack of contrast, which I immediately tipped was due to a faulty video detector diode. Sure enough a new one, again an OA90, restored full contrast with plenty to spare. Coupled with all the other things I had done to it, it produced a really beautiful picture. I was proud to return it to the owner and demonstrate how good it was.

Unfortunately my satisfaction was short-lived. Three days later the owner was on the phone. The picture had gone "all funny again. All pale and weak". It had too, but I wasn't prepared to believe that it was another diode. After all, who ever heard of two diodes failing in such rapid succession.

As a result, I checked just about every other likely cause — and found nothing. Eventually I was more or less forced to check the diode because I had nothing else left to check. Sure enough, it had gone too.

I replaced it, but had to substitute another type, having temporarily run out of OA90s. (I put some on order right away.)

This one lasted about a week, then it, too, packed it in. I replaced it again, this time with the correct type, but I didn't feel very confident.

Sure enough, it failed after a few days, as did the next one. By this time I was pretty desperate. There was obviously something wrong somewhere, and I just had to find it. But what was it?

The only theory I could advance was that there was an intermittent short in the video amplifier, a 6KD8, between screen and grid. If there was, it would apply excessive voltage to the diode, which was directly coupled to the grid.

Finally I wrote to the set manufacturers. I related the history of the set and advanced my own theory as to the possible cause. Had they encountered this problem before? Was my theory a reasonable one? If so, what modifications did they suggest? Finally I indicated my intention, if they were unable to help, of rewiring the detector stage to take a 6AL5 valve.

While I waited for a reply, I mocked up the proposed 6AL5 modification, just to establish that it could be done. It was a pretty crude arrangement, and the leads were longer than they would need to be if the job was done properly. As a result, it did degrade the picture definition slightly, but not by enough to worry the average viewer.

As can be imagined, the customer was becoming impatient by now, wanting to know how long it would be before he could have his set back. Since I didn't know how long it would take the manufacturers to reply to my letter, or how long it would take me to act on their advice — if, indeed, they were able to offer any — I finally took the easy way out.

I explained to the customer what I had done to the set, and about the letter to the makers. I told him he could take the set as it was, mock up and all, for the time being. When I had finally solved the problem I would take the set back and restore it to its original form, plus whatever modifications were necessary.

He was quite happy to do this, and I was happy to get him off my back.

Not long after that I received a reply from the manufacturers. According to them, my diagnosis as to the cause of the trouble was correct. This was the first model that had used the 6KD8 in the video amplifier position and they had experienced some trouble due to flashovers. The remedy was to fit a protective resistor of about 200 ohms in series with the diode.

Unfortunately, I haven't been able to do anything about it. The owner doesn't want me to touch it.

"That's the best its ever been", he said. "I don't want anything done to it now. If it keeps on working like that I'll be perfectly happy."

Right now I don't know what is the best thing to do. Ths customer really means what he says, and any attempt on my part to force the issue may well antagonise him. On the other hand I know it isn't right. Nor do I want a bodgie set-up like that lying around where other technicians may perhaps see it and — worse still — ask who did it.

(Continued on Page 116)

CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome.

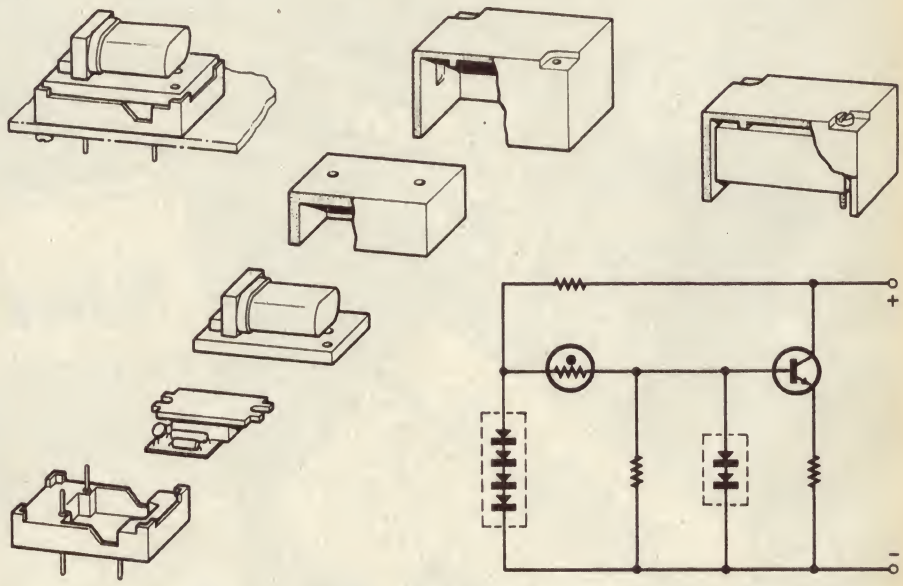
Temperature Control For Crystal Oscillators

This temperature control device is adaptable to many of the crystal holders currently in use. The control circuit of the TCD is designed for proportional control, each temperature of the sensor being associated with a certain heating power for corrective action. The temperature sensor is a positive temperature coefficient resistor. The sensor's resistance increases with rising temperature, the power transistor current decreases and with it the applied power for heating the crystal. The mean crystal chamber temperature is chosen at $+75 \pm 5°C$.

Notwithstanding the simple design of the control circuit, a very favourable control characteristic has been achieved. Typical variations of the mean crystal chamber temperature over the operating temperature range of 0 to $+65°C$, are $\pm 1.2°C$.

The small dimensions and insulating air gap between heating sheath and case make it possible to operate with a power input of about 2.2 watts for an ambient temperature of 25°C. In applications where size is not a factor, the power input can be reduced by about 40% by insulating the unit with expanded polystyrene with a wall thickness of about 5mm.

The diagram shows constructional details of the unit. To assure uniform heat distribution, the crystal unit is surrounded by a heating sheath made of a diecast aluminium case and an aluminium plate. The crystal chamber is heated by the power transistor which is mounted underneath the aluminium plate. The electrical components of the control circuit are arranged together on a printed board, located immediately below the power transistor.



Through integration of the baseplate, aluminium plate with socket and control circuit to form the lower section, while the cover with the heating sheath forms the upper section, crystal changing is very simple. After the head screws have been slackened, the upper section can be lifted off and the crystal removed.

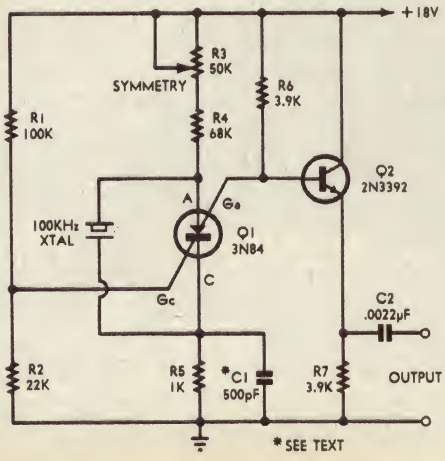
The lower section with its four connecting leads injection moulded into the baseplate remains attached to the printed board to be equipped with components all the way up to the temperature control device. A strip of foam plastic glued to the inside of the heating sheath holds the crystal in position and guards against vibration and shock. (From "Siemens Electronic Components Bulletin".)

SCS Crystal Controlled Oscillator

It is usual for the silicon controlled switch to be thought of as controlled at the cathode gate, or occasionally, at the anode gate. But the SCS can be controlled quite sensitively at the anode as well. The circuit in the diagram below is an excellent example of this. Here, the alternating potential developed across an oscillating quartz crystal (connected between anode and cathode of Q1) controls the anode-gate current at a repetition rate of 100KHz, the resonant frequency of the crystal.

The output waveform of this circuit is approximately rectangular. The limit of the positive-going excursion needs to be modified by cathode capacitor C1. This is simply because the turn-on of the SCS is quite sharply defined, but the turn-off is not nearly as rapid or as clean. The condition is aggravated by the repetition rate of 100KHz, which is quite high for the SCS.

The value of 400PF proved to be about right for C1 in the prototype, but in another assembly of the instrument some modification of the value of this capacitor might improve the squareness of the output waveform. If C1 is made too small, considerable rounding will occur in the leading edge of the wave's positive-going excursion, while too large a value will produce overshoot. If the value of C1 is much too high, it will cause the crystal to lose control of the frequency.



The setting of potentiometer R3 determines the symmetry of the output waveform, ie, this control should be adjusted to equalise the duration of the wave's positive and negative-going excursions.

Output from the SCS is taken at the anode-gate and fed directly to the base of bipolar transistor Q2, which is connected to operate as a common-collector amplifier (emitter-follower). Output from Q2, taken at the emitter, is fed to the output terminal via capacitor C2. Current consumption of the circuit is about 5mA at 18V DC.

(By Frank H. Tooker, "Electronics World".)

Just add sound

A simple statement, but to the many professional audio engineers using EMITAPE it means flawless recording. EMITAPE provides the qualities of low modulation noise, good dynamic range and signal-to-print ratio so essential in professional sound. Of course you don't have to be a professional to appreciate EMITAPE quality. It is inherent in all types of EMITAPE in reel and cassette. Try it for your next recording and hear the difference.

not just any tape **EMITAPE**

E.M.I. (Australia) Limited. Branches in all Capital Cities.

EMI

State-of-the-Art 144MHz Preamplifier

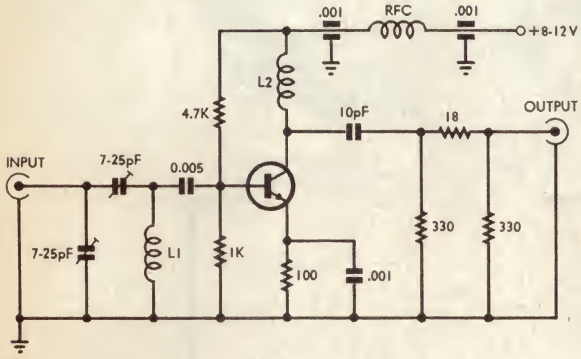
After several years in which the trend of solid-state 144MHz front-end amplifiers has been towards FET devices (experimental FET devices have now been developed by GEC for use up to 1GHz), we could yet see a swing back to bipolar transistors. In "QST", April 1971, J.R.Hattaway, K5PKV, and Donald Belcher, WA4JVE, describe a preamplifier with such exceptional performance that Ed Tilton, W1HDQ, "QST's" VHF Editor, feels constrained to add a note emphasising that "this is no April Fool thing: the amplifier does all that is claimed for it by the Authors".

The amplifier. which works equally well on 432MHz, provides high gain (around 23dB) and has a noise figure of 1.5dB at 144MHz (and under 2dB at 500MHz), plus good intermodulation characteristics — and achieves all this without the traditional problem of neutralisation!

There is at present, one quite formidable snag: the amplifier is designed around a new generation of microstrip-packaged transistors (the Texas Instruments' MS175 series) and these do not come cheaply. "QST" puts the cost in the USA of the transistor as $16, or about $25 to build the complete amplifier; some may find this a rather expensive way of (as G3GGK and G3EDD put it recently) "dredging around in the noise for exotic DX". Nevertheless it seems well worth drawing attention to this new generation of VHF/UHF transistors which are already being put to various uses in professional equipment.

The "QST" article lists a number of precautions to take when using these devices. For example, the silver alloy leads are quite fragile and should be formed only once; the input and output circuits have to be kept physically separate; a 330-ohm resistor should be inserted in series with the amplifier the first time it is powered (if all is well about half the supply voltage will be dropped across the resistor). And for maximum benefit, such an amplifier should preferably be mounted at the mast-head to avoid the effects of signal losses in the coaxial feeder. For anyone seriously contemplating building one of these high performance amplifiers, we would suggest that the "QST" article be consulted.

(From "Radio Communication".)



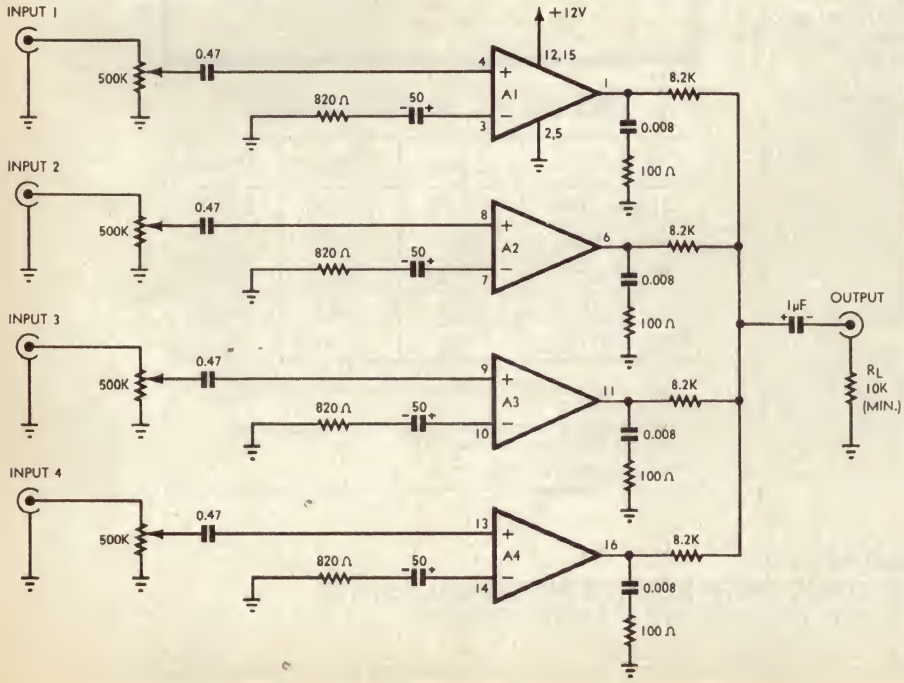
L1-8 turns 22 gauge on 1K ½W resistor. L2 5½ turns on 10K ½W resistor. RFC 10 turns 33 gauge enamel, toroid on ferrite bead. The foregoing details are for 144MHz. A similar arrangement can also be used for the 70cm band.

Four-Channel Audio Mixer

The RCA CA3048 IC amplifier array consists of four independent identical amplifiers that can operate from a single power source. This 16-lead dual-in-line plastic packaged IC is ideal for use as an audio mixer when connected as in the diagram. This circuit. is taken from Application Note ICAN-4072:

Each input signal is fed to the input of one of the four amplifiers through a 500K gain control potentiometer and series DC blocking capacitors. The gain per stage from input to output, determined by the value of the feedback resistor between ground and the inverting (-) input. is 20dB for the circuit constants shown. Gain of the individual stages is 34dB but there is a loss of around 14dB in the mixing networks consisting of the 86K series resistors and load resistor. The series R-C networks composed of .008uF capacitors and 100-ohm resistors stablise the amplifiers when source and load conductances are too small to provide adequate damping.

(From "Radio-Electronics".)



Rawl Plugs For Tool Handles

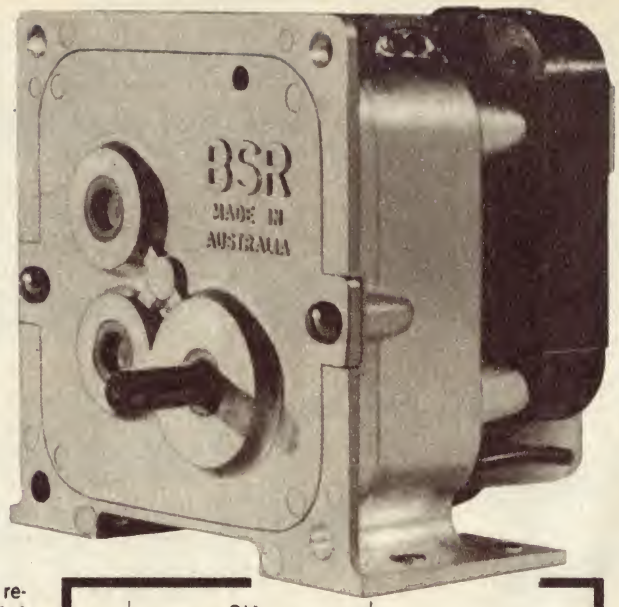
The annoyance of small files and other tools continually loosening and dropping out of their handles. is eliminated by removing the file and driving a Rawl plug into the hole in the handle. then forcing the file tang back into the plug.

(By H. Muller, "Radio-Electronics".)

BSR

SUB-FRACTIONAL HORSEPOWER

Geared Motors



The VPS100 gear box is designed for applications requiring a compact, powerful drive unit and features a die-cast housing, sintered bronze bearings; machine-cut steel gears and pinions plus a non-metallic gear in the first reduction to keep noise to a minimum.

These units are designed to provide greater durability and are particularly suitable where continuous duty is required. All gears are grease lubricated.

They can be adapted to horizontal or vertical mounting and overall dimensions for the VPS100 motor and gear box are 3" x 3" x 3".

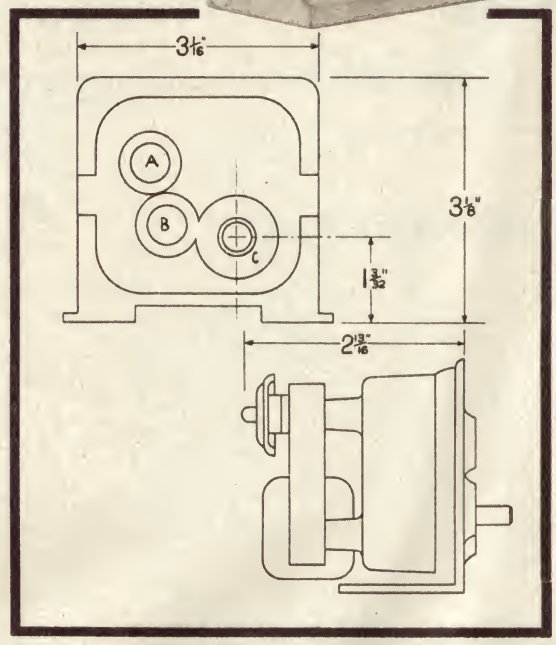
In the standard range, 38 alternative output speeds are available, from as low as 0.9 r.p.m. to 368 r.p.m. (Other speeds are also available but require special gears.)

The wide range of ratios available, together with the choice of 3 output shaft positions, A, B or C, gives great versatility in mounting and speed selection and make the VPS100 adaptable to many applications without expensive re-tooling.

For a unit of such compact dimensions, the torque output is considerable and, when powered by a ½' shaded pole motor, gives, e.g., 46 lb./in. at 0.9 r.p.m.

In those cases requiring still higher torque output and continuous operation a 1" shaded pole motor can be fitted. Alternatively, for intermittent use higher rated ½" or 1" motors are available if required.

In those applications where space is restricted an open gear box, type VPS101, can be provided, having the same general characteristics as type VPS100.



STANDARD BSR GEARED MOTOR VARIATIONS WITH ½" STACK SHADED POLE MOTOR.

VPS 100 A			VPS 100 B		
RPM No. Load	Starting Torque	Output Shaft Position Alt.	RPM No. Load	Starting Torque	Output Shaft Position Alt.
0.9	46 lb. in.	A or C	1	27 lb. in.	A or C
2.7	10.5 lb. in.	B	3	11.5 lb. in.	B
3.7		B	4.5		B
5		B	6		B
5.8	8.5 lb. in.	A or C	7	6.25 lb. in.	A or C
8	8.25 lb. in.	A or C	10	5.75 lb. in.	A or C
9.5		B	15.5	3.5 lb. in.	B
11		A or C	25		A or C
13	4.25 lb. in.	B	30	2.75 lb. in.	B
20		A or C	34.5	30 oz. in.	A or C
24	3.25 lb. in.	B	40		B
28	2.75 lb. in.	A or C	56.5		B
33		B	76	14.5 oz. in.	B
47		B	90	14 oz. in.	A or C
63	1.75 lb. in.	B	124		A or C
74	1 lb. in.	A or C	167		A or C
100		A or C	270	3.75 oz. in.	B
139		A or C	368	3.5 oz. in.	B
223	6.75 oz. in.	B			
304	4.75 oz. in.	B			

PRICE LIST VPS 100 MOTOR/GEARBOX

Quantity	½" Motor	1" Motor	1½" Motor
Single Unit	$10.73	$12.30	$14.79
2-15 Units	9.66	11.07	13.31
16-50 Units	9.12	10.46	12.57
51-100 Units	8.05	9.23	11.09
Over 100 Units	6.97	8.00	9.61

Prices for other than standard output speeds available on application.

Note: Quantity buys apply only to motors/gearboxes with the same specifications.

Prices apply in Australia only.

BSR

BSR (A'ASIA) PTY LTD
ANNE STREET SOUTHERN SECTION INDUSTRIAL ESTATE
ST. MARYS NSW TELEPHONES 623 0375, 623 0376

NEW ZEALAND GPO BOX 2630 AUCKLAND **BSR:P92R**

Converter for Amateur TV

Here is a receiving converter for the 432MHz amateur band which is ideal for use with a normal TV receiver to "look in" on amateur television (ATV) transmissions. Easily built and using only a small number of components, it would be ideal as a youth radio club project.

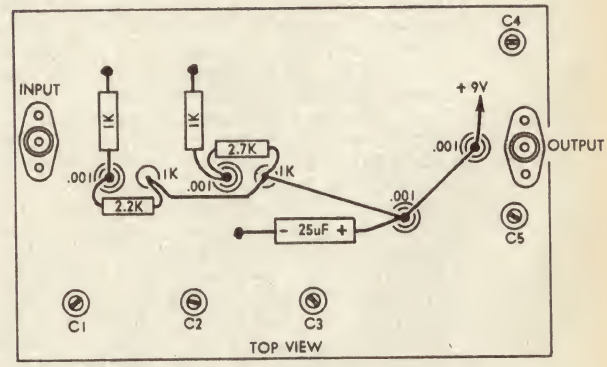
The converter design shown on this page was described by Ian McKenzie, VK2ZIM, in the monthly newsletter published by the VHF and TV Group, Wireless Institute of Australia NSW Division. It is reproduced here by kind permission of the group, in the hope that it may help to foster more interest in amateur TV activities.

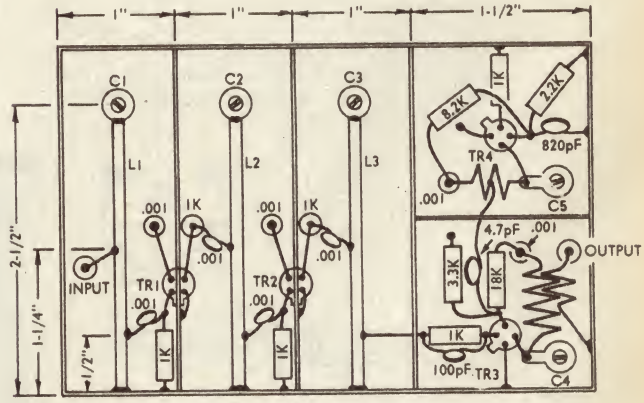
As may be seen, the converter consists of two RF amplifier stages, a mixer stage and a free-running local oscillator, all using BF180 or similar UHF bipolar transistors. The RF stages use the grounded-base configuration, with signal tuning performed by trough lines. Output from the second RF stage is fed into the emitter circuit of the mixer, while the local oscillator signal is fed into the base. The IF output circuit in the mixer collector circuit and the local oscillator frequency may be adjusted so that the converter output appears on any suitable unused channel. The output of the converter connects directly to the aerial terminals of the TV receiver, via a suitable balun if necessary.

Although quite suitable for TV reception, the stability of the free-running local oscillator would probably not be good enough for reception of AM or FM phone signals. However a crystal-locked oscillator chain could be substituted if desired.

The physical construction of the converter should be fairly clear from the diagrams at right. Each trough-line consists of a 2½in length of 1/8in brass brazing rod, centred in the 1in x 1in troughs formed by the partitions in the brass or tinplate box. Suitable trimmers for the tuning would be the Philips type CO04-AA, or the similar types CO04-BA, CO04-CA, CO04-JA, all of which are available in 0.8 — 6.0pF.

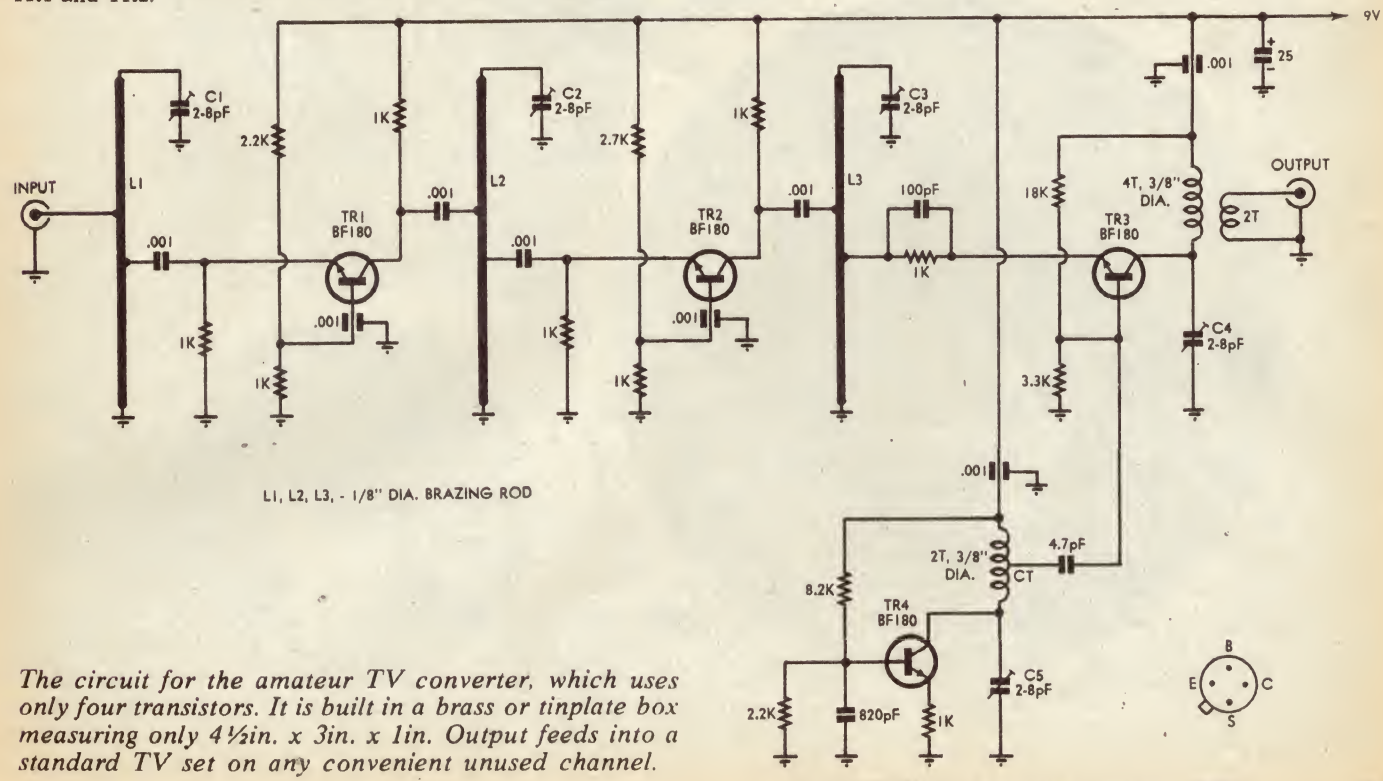
Note that the trough partitions are notched to accommodate TR1 and TR2.





BOTTOM VIEW
ALL TRANSISTORS BASE UP

BOX, 4-1/2" x 3" x 1" BRASS OR TINPLATE.



The circuit for the amateur TV converter, which uses only four transistors. It is built in a brass or tinplate box measuring only 4½in. x 3in. x 1in. Output feeds into a standard TV set on any convenient unused channel.

"MSP Diminuette"

Designed to provide big performance where size is limited by necessity, or styling requirements, the Diminuette sound system is the engineered solution to the problem of small enclosure operation. It incorporates a six-inch wide-range speaker and a new three-inch tweeter specifically intended for small enclosure application. The tweeter uses a proven curvilinear principle, producing crisp brilliance and bringing modern recordings to life. These are coupled in a petite enclosure and provide true full-range high-fidelity sound.

The enclosure may be constructed as either an 8 or a 15 ohm system to suit popular valve or solid-state amplifier requirements. The response is smooth and essentially flat from 80 Hz to 16 kHz but a much greater bass sensitivity can be obtained with a small amount of boost. Rapid transients are handled with ease. Boom is avoided by solid construction and by liberally lining the enclosure with Innerbond. For complete details contact **Manufacturers Special Products Pty. Ltd., 47 York Street, Sydney, Phone 2 0233;** or your nearest distributor.

M
S P

Sydney 533 1277 & 29 7031.
Melbourne 67 9161. Perth 28 6400.
Brisbane 41 1631. Adelaide 51 0111.
Hobart 34 3836. Launceston 2 1804.

Radio Transmission

Electromagnetic radiation — radio waves — the escape of energy from charging and discharging reactance — the transmitting aerial — the use of a high-frequency carrier — frequency and wavelength — generating the RF carrier — RF oscillators — RF amplifiers — keyed CW transmission — amplitude modulation and AM transmitters.

In the first eight chapters, we have been introduced to the basic components or "building blocks" of electronics — resistors, capacitors, inductors, valves, transistors, and so on. We have also seen something of the various ways in which these components may be connected together to make elementary circuits.

It is important that one has a firm grasp of these matters before one attempts to delve into the more practical aspects of electronics. However, there are no doubt many readers who have so far been thinking along the lines — "All these components may be very interesting, but how are they used to send messages and music — or even pictures — to a distant place, without any physical connection?"

With this chapter we begin to answer such questions, for we are now in a position to start examining how electronic components may be put together to transmit intelligence (whether it be messages, music, or pictures) from one point to another — without wires. In other words, we are now going to look at the basic principles of radio transmission and reception.

The whole of radio depends upon the fact that a certain form of energy, called "electromagnetic radiation," can travel from one place to another practically instantaneously, and even through a vacuum or the near-vacuum of outer space.

You are already familiar with at least two types of electromagnetic radiation — light and heat. You are also aware that these two forms of energy radiation can travel through the near-vacuum of space — step out into the sunlight, and you have proof that energy is traversing the 93 million or so miles between the sun and you. It warms your body, it can stimulate the retina of your eye, it can be used to evaporate water, and so on.

Radio waves are simply another sort of electromagnetic radiation, along with light and heat. We shall see in a moment how these three forms differ from one another; first we must learn just what electromagnetic radiation really is. To explain this fully we would need to delve into lots of mathematics, but we're deliberately going to simplify the story so that you will be able to form a mental picture of just what is going on.

In an earlier chapter, we saw that the application of a voltage or EMF to a capacitor caused the capacitor to "charge up." We saw that this was a process whereby the space between the two capacitor plates became "strained" or in a state of tension. We called this state of tension an electric field, and we said that it was stored energy which could be returned to the circuit when the capacitor was discharged.

In another chapter, we saw that passing a current through an inductor sets up a magnetic field around the inductor. The magnetic field, like an electric field, is a state of tension in space, but it is a different type of tension. It represents another sort of stored energy, which we said could be returned to the circuit when the field was allowed to collapse.

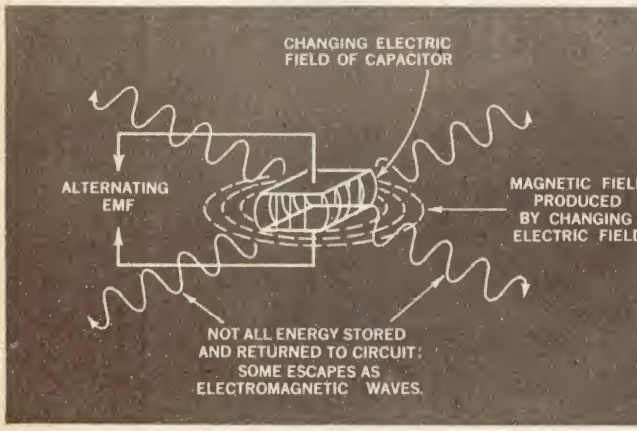
Now, in implying that all the energy stored in electric and magnetic fields could be returned to the circuit, we were simplifying the situation slightly. We did it to emphasise the difference between the basic energy storage behaviour of reactance (capacitance and inductance), as opposed to the energy dissipation (conversion to heat) behaviour of resistance.

In actual fact, however, not quite all the energy stored in an electric or magnetic field is returned to the circuit. Some is lost — it escapes, and flows or radiates away from the capacitor or inductor like the ripples from the surface of a pond disturbed by a stone. It can be picked up at a distant spot, by a suitable detecting device.

It happens that the form in which it radiates is the same in both cases — it doesn't escape from the capacitor as electric field alone, nor from the inductor as magnetic field alone. In both cases, the energy is radiated as combined electric and magnetic fields — hence the name, "electromagnetic" radiation.

The reason why the energy radiated is in the form of a combined field is that a changing field of either type is always accompanied by the other type. One can't have a changing electric field without a magnetic field along with it, nor can there be a changing magnetic field without an electric field. This is just a fact of life; no-one knows why, nor do we know just why the energy "radiates."

Let's just summarise these ideas about electromagnetic radiation before we go any further: the total energy "stored" in a capacitor or in an inductor, in their respective types of field, can never be fully returned to the circuit, because some of it escapes or "radiates" away. It escapes as a combined electromagnetic field, which is produced during the charging and discharging processes when the fields are changing (building up or collapsing) because whenever one type of field changes



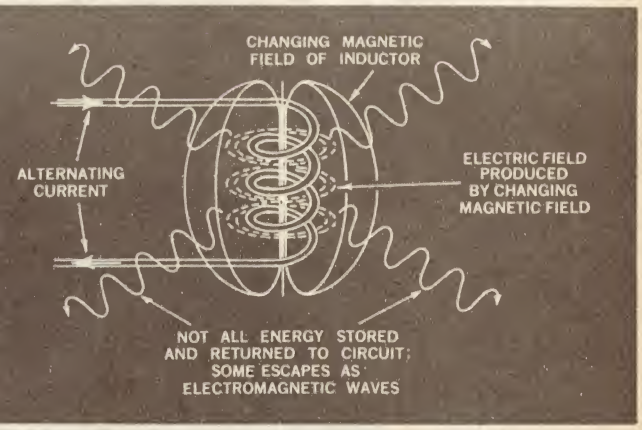


Figure 1 (left): The alternating electric field produced when a capacitor is connected to an alternating EMF is accompanied by a similarly alternating magnetic field. Figure 2 (right): With an inductor the converse occurs. In both cases some energy escapes as radiation.

LEADER TEST INSTRUMENTS

A WIDE RANGE OF LOW COST TEST INSTRUMENTS INCLUDING:–

OSCILLOSCOPES, SWEEP GENERATORS, VTVM, AUDIO GENERATORS, SIGNAL GENERATORS, TRANSISTOR CHECKERS, ATTENUATORS, PROBES.

LSG-11 WIDE BAND SIGNAL GENERATOR

Probably the most popular low cost Signal Generator in the world. This signal generator has a useful frequency range from 120 kHz to 130 mHz and using an optional crystal, can be crystal controlled. Adjustable output modulation frequencies of 400 and 1000 kz can also be used for testing audio amplifiers.

*** $45.00 + S. TAX**

LAG-55 AUDIO GENERATOR

The LAG-55 is an indispensable instrument for audio work. Three different waveforms, (sine, square and complex) are available for a variety of tests. The wide frequency range from 20Hz to 2MHz and constant output levels are most desirable features of the LAG-55. Sine waves are generated with a Wien-bridge configuration and square waves by a Schmitt trigger circuit.

*** $85.00 + S. TAX**

LDM-810 GRID DIP METER

The well known Leader LDM-810 Grid Dip Meter is one of the more useful instruments for checking receivers, oscillators, transmitters and circuit components.
A frequency range from 2 to 250 MHz (in 6 bands) is available with an internal modulation frequency of 1 kHz.

*** $45.00 + S. TAX**

LBO-52B 5" OSCILLOSCOPE

The LBO-52B Oscilloscope has been designed for high performance operation wideband, DC to 10 MHz with a high sensitivity of 10 mV p to p makes it an invaluable tool in the development and testing of electronic circuits. It is especially useful in the examination of low level equipment such as tuners, IF amplifiers etc.

*** $295.00 + S. TAX**

LBO-3IM 3" OSCILLOSCOPE

The LBO-3IM is a compact oscilloscope designed for all round service. Its small and handy size will appeal to experimentors, servicemen and plant technicians who demand maximum performance with minimum space requirements. Responses from 3 Hz to 1 MHz and sensitivity is 80 mV/cm.

*** $137.50 + S. TAX**

LPB-10Z LOW CAPACITANCE PROBES

The LPB-10Z is a high impedance probe specially designed for Leader LBO-52B, LBO-55B, LBO-32B, LBO-33B Oscilloscopes. Its use prevents any disturbance to the circuit under test. Input impedance is 10 MΩ shunted by 18 pF and attentuation is 20 dB.

*** $16.50 + S. TAX**

CATALOGUES AVAILABLE ON REQUEST.

Distributed by:

WARBURTON FRANKI

* NOTE THAT THESE ARE SUGGESTED LIST PRICES ONLY AND MAY VARY SLIGHTLY IN SOME AREAS.

AVAILABLE FROM LEADING ELECTRICAL SUPPLY HOUSES.

WF5101

it produces the other type.

When the field of a capacitor or of an inductor is built up or allowed to collapse, then, a small "wave" of electromagnetic energy radiates away in all directions. But if we apply an alternating EMF to the capacitor or inductor, a continuous series of electromagnetic waves will be produced. The continuous build-up-decay-reversal nature of the field in the capacitor or inductor will produce electromagnetic energy which will radiate away in waves, the waves having the same frequency as that of the alternating EMF.

What we know as radio waves are electromagnetic waves produced by currents so that they have a frequency of from about 10,000 Hertz to about 100,000,000,000 Hertz.

Incidentally, when discussing the frequency of radio waves or of the currents which produce them, the simple unit of frequency the Hertz (Hz) often becomes unwieldy. Things are simplified by using the Kilohertz (KHz), which is equivalent tc 1,000 Hz, the Megahertz (MHz), which is equivalent to 1,000,000 Hz, and the Gigahertz (GHz), which is equivalent to 1,000 MHz.

The radio frequency spectrum thus extends from about 10 Kilohertz (10KHz) to about 100 Gigahertz (100GHz). The alternative descriptions in terms of wavelength (long-, short-, medium-, micro-waves, etc.) are less often used, but describe the length of one cycle of the electromagnetic waves concerned.

The lengths of electromagnetic waves are inversely proportional to frequency, which means that the higher the frequency, the shorter the wavelength, and vice-versa. Wavelength is measured in metres, and the length of a wave in metres is given by its frequency in Megahertz (MHz) divided into 300. Waves of a frequency of 100 MHz thus have a length of 3 metres, and so on.

We said before that light and heat were electromagnetic radiation, but that they differed from radio waves in some way. In fact, they differ in terms of frequency. Heat radiation is in effect super-high-frequency radio waves or "Extra-short" microwaves, while light radiation is a higher frequency again. Light waves are so short that their wavelength is measured in Angstrom units (an Angstrom is a ten-thousand-millionth of a metre).

But let us return to radio waves and their generation. When people first observed that energy was radiated from a changing electric or magnetic field, and saw that it could be picked up at a distant spot, they started thinking.

Surely, they reasoned, this effect could be used to transmit intelligence from one point to another. And thus was born the idea of using radio waves as a means of communication.

Experiments showed that radio waves could be radiated in more efficient ways than from a simple capacitor or inductor. There have thus been developed various types of special radiating devices, which you will probably be familiar with as aerials. A properly designed aerial stores very little energy fed into it — it lets most of it escape, as radiation.

At this stage, it might be thought that to transmit messages by radio, one need simply speak into a microphone, amplify the resulting voice-frequency voltages with a valve or transistor amplifier, and feed the amplifier to an aerial. Then, it might be reasoned, one would only need another aerial and an earphone to receive the message at a distant spot.

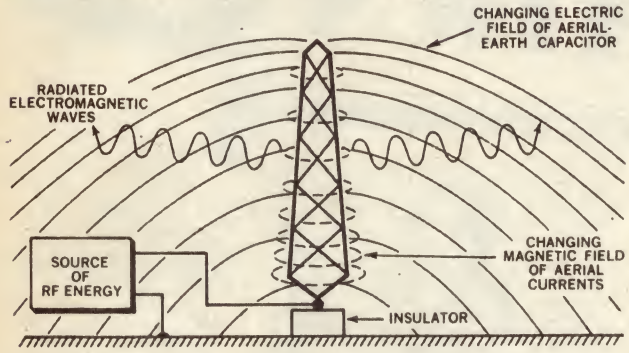


Figure 3: A transmitting aerial is a device specially designed to radiate energy. It combines the features of a capacitor and an inductor.

Now while messages can be and have been sent in this way, it actually proves quite difficult to satisfactorily transmit electromagnetic waves with frequencies as low as those we can hear (between about 30 Hz and 16 KHz). Transmitting aerials miles in length are needed if practical amounts of energy are to be radiated. There are also other difficulties associated with the transmission of such low frequencies, but these need not concern us here.

It so happens that higher frequency waves are easier to radiate. Efficient aerials may be made in convenient sizes, which will radiate suitable amounts of energy if high frequencies are used.

In practice, then, we do not radiate voice-frequency radio waves. We radiate at considerably higher frequencies, called radio frequencies (RF), by supplying the aerial with alternating current generated by an RF oscillator and amplified by an RF amplifier. These may use valves or transistors, as we shall see a little later on.

The broadcast radio stations radiate waves with frequencies in the range 550KHz-1500KHz. Long distance communication stations operate from about 2MHz to 30 MHz, in what is called the "short wave" or high-frequency (HF) band. Television stations transmit waves at frequencies between about 50 MHz and 250 MHz (the VHF band), and so on.

Radiating at radio frequencies is desirable from the ease-of-transmission-of-energy point of view, then, but it complicates the procedure of sending messages. Unfortunately, human beings can neither talk nor hear at radio frequencies!

Means must, therefore, be used whereby our RF waves can be used as a vehicle or "carrier" for the information to be transmitted. This is called "modulating" the RF carrier.

The simplest way of doing this, and the way that was first used, is to arrange that the alternating RF currents fed to the transmitting aerial are turned on in bursts or pulses. The pulses are arranged to be either long or short in duration, and various combinations of long and short bursts made to correspond to letters of the alphabet and numerals.

This type of transmission is known as keyed carrier wave transmission, or just "carrier wave" (CW) transmission. And the code used to pulse the carrier wave in short ("dots") and long ("dashes") bursts is, of course, the familiar "Morse" code.

With CW transmission the operator is provided with a "key," which is a switch connected to the transmitter. The key is arranged so that in its rest position the RF oscillator and RF amplifier send no energy to the aerial. When the key is pressed down, however, the oscillator and amplifier are turned "on", and by pressing the key briefly or for slightly longer the operator can send short or long bursts of RF energy to the aerial — to be radiated as dots and dashes.

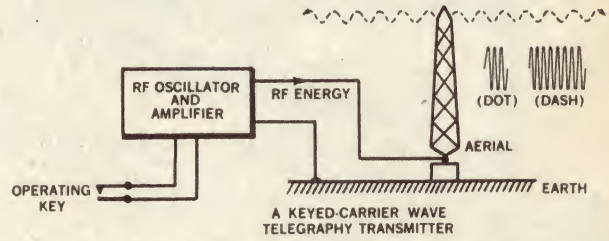


Figure 4: A keyed-carrier or CW transmitter is a system for radiating messages as long or short bursts of RF waves.

A long burst followed by three short bursts means "B", for instance, while a short burst followed by a long means "A." Each letter of the alphabet and numeral is represented by a particular combination of short and long bursts.

Keyed carrier wave transmission is quite satisfactory as a means of transmitting simple messages, but it obviously lacks something where speech, music or pictures are concerned. Who would be able to recognise their favourite piece of music translated in to dots and dashes?

Fortunately, there are other ways of modulating the RF carrier in order to send information, besides the simple on-off modulation of keyed CW transmission. Although there are quite a large number of alternative modulation systems, we will confine ourselves here to the discussion of only one — that used by all the normal "radio" broadcasting stations.

The broadcasting stations amplitude modulate (AM) the RF carrier. Rather than switch the carrier through only two steps of amplitude (off and on), they vary its amplitude continuously. In this way, the

Now YOU can build electronic gadgets

IT SOUNDS FANTASTIC . . . BUT IT'S TRUE!

everyday electronics

NOV. 71
40 cents

No.1 OUT NOW

A NEW MAGAZINE BRINGING A FASCINATING HOBBY TO EVERYONE

PROJECTS EASY TO CONSTRUCT
THEORY SIMPLY EXPLAINED

Have fun building this super portable record player

FREE GIFT

FREE IN THE No1! ISSUE

PRINTED WIRING BOARD

A must for motorists . . . make your own windscreen wiper control!

HOME SENTINEL . . . excellent deterrent to burglars! Lights up your home as night falls!

This exciting new magazine will give you all the know-how needed to make electronic gadgets for your home, car and other hobby applications. Just follow the easy, step-by-step illustrated constructional details and articles on techniques and theory. And that's it.

The FREE Printed Circuit Board acts as a base on which two of the projects can be constructed.

FEATURES FROM No. 1

"TEACH-IN" . . . important series outlining the theory and practical techniques involved in electronics. "SHOP TALK" . . . advice on buying components and equipment. "ELECTRONICS PAST AND PRESENT" . . . illustrated account of the electronics story to date.

GET THIS GREAT NEW MAGAZINE—ONLY 40 CENTS

continuous variations of the human voice or music can be transmitted faithfully, as similar variations in the strength of the radiated waves.

In the remainder of this chapter, we will see how this is done. Following chapters will be devoted to the operation of the receiving end of the system, to show how the receiver is able to recover the original transmitted voice or music from the amplitude modulated waves.

Before we examine how the signals to be transmitted are made to amplitude modulate the RF carrier, we should have a look at the way in which the RF carrier is generated in the first place. In other words. We should look at the RF oscillator, which perhaps can be regarded as the "heart" of any radio transmitter.

You may remember that in chapter 5 of this course, we saw that a capacitor and an inductor may be connected in parallel to form a parallel tuned circuit. We saw that when such a tuned circuit is fed with a short burst of energy, it tends to oscillate, producing a decaying or "damped" alternating voltage.

The frequency at which the circuit oscillates, which is the frequency of the alternating voltage, is determined by the resonant frequency of the tuned circuit. This in turn depends upon the values of the capacitor and the inductor, as one might expect.

In fact, the frequency of the voltage produced is given by

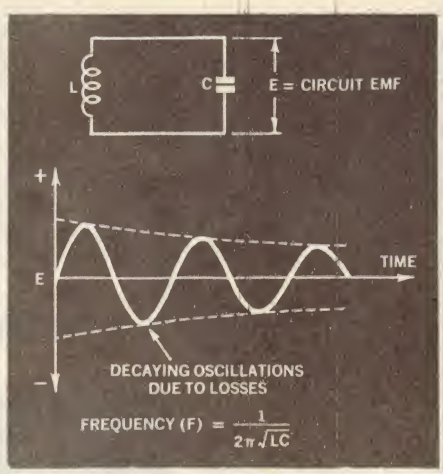
$$F = \frac{1}{2\pi \sqrt{L.C.}}$$

where F is the frequency in Hertz, pi is 3.1416, L is the coil inductance in Henries, and C is the capacitor value in Farads.

A tuned circuit can thus be used to generate an alternating EMF of any desired frequency, by suitable choice of the inductor (coil) and capacitor. So if we want to generate an RF carrier of a certain frequency, we can select a capacitor and coil to resonate at this frequency.

But a tuned circuit alone is not sufficient, for it has coil resistance and other losses which make the alternating voltage decay and die away. To produce a continuous, steady supply of alternating EMF at our carrier frequency, we must arrange for the tuned circuit to be continually fed with energy, to overcome its losses and keep it oscillating.

Here is where valves or transistors or other amplifying devices enter the picture, for by means of a valve or transistor we can keep the tuned circuit oscillating steadily.



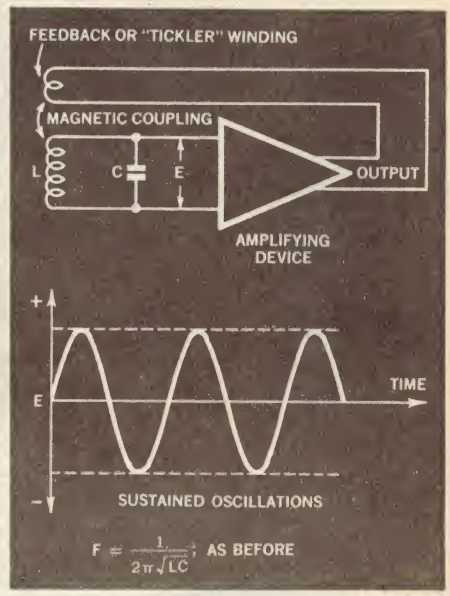


Figure 5 (above): Oscillation of a parallel tuned circuit. Figure 6 (right): Using an amplifier to maintain the oscillations.

By the way, note that wording carefully. It is always the tuned circuit which oscillates, not the valve or transistor. The amplifying device simply keeps the tuned circuit going.

Figure 6 shows the basic operation of a simple tuned circuit oscillator. The amplifying device is connected so that it picks up the oscillatory voltage E appearing across the tuned circuit. The output of the amplifying device is then connected to a feedback or "tickler" winding which is placed close to the inductor of the tuned circuit.

The feedback winding is arranged so that it can magnetically induce voltages into L which re-enforce the voltage E, when fed with an amplified version of E by the amplifying device. In this way, the tuned circuit is fed with energy which keeps it oscillating steadily.

The amplifying device may be a valve, a transistor, or anything else capable of doing the same job. Figure 7 shows simplified circuits for tuned oscillators using a valve and a transistor.

In the valve circuit, the tuned circuit voltage is fed to the input of the valve, which passes the corresponding amplified plate current oscillations through the feedback winding to supply energy back to the tuned winding.

The transistor circuit does the same thing in a different way. It connects the tuned circuit in the collector (output) circuit of the transistor, and uses a small feedback winding to supply the input circuit of the transistor. Thus small oscillatory voltages induced in the feedback winding are amplified by the transistor and fed directly to the tuned circuit.

In all oscillator circuits of this type, the amplifying device not only supplies the tuned circuit with enough energy to overcome losses and keep it oscillating. It supplies more than enough, so that a small amount of the oscillatory energy of the tuned circuit can be picked off for external purposes — in our case, for amplification and supply to the transmitting aerial.

This "output" of the oscillator can be obtained in a number of different ways. A third winding may be used, magnetically coupled to the tuned and feedback windings, to produce an induced EMF, as shown in the valve circuit. Or a connection may be made directly across the tuned circuit, as shown in the transistor circuit. Or various other methods may be used, depending on the sort of oscillator actually used and the amplifier circuit which is to be connected to the output.

In our discussion of oscillators so far, we have been talking in terms of L-C parallel tuned circuits. However, oscillators using such tuned circuits tend to waver or "drift" in frequency. Only to a small degree, if the circuit is well designed, but generally enough to make them unsuitable as a source of RF carrier energy in a broadcast transmitter — for transmitters must radiate on a fixed frequency, or one would never quite know where to find them on the receiver dial!

Actual radio transmitters do not use L-C tuned circuits in the RF oscillator, for this reason. They use instead a carefully prepared wafer of quartz crystal, which has the property of resonating mechanically when an EMF is applied to opposite sides of the wafer. When it is made to oscillate, it does so with very much less frequency drift than a normal tuned circuit, particularly if it is kept at a constant temperature in a thermostatically controlled oven.

The frequency of such crystal-controlled RF oscillators is set by the dimensions and preparation of the quartz crystal. To change the frequency, the crystal must either be

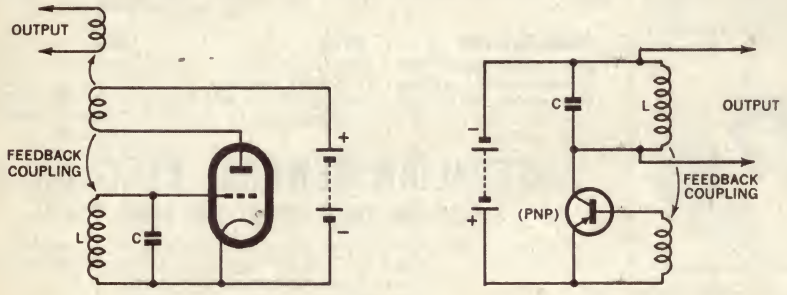
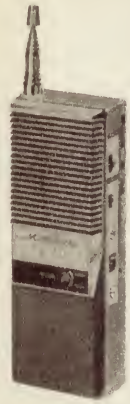


Figure 7: Elementary tuned oscillators. One uses a valve to provide the amplification, the other a transistor. The circuits illustrate different ways of providing feedback and output coupling.



At last a breakthrough in the cost for high quality portable radio transceivers of the walkie-talkie hand-held type. We are introducing and offering for sale a fully PMG approved

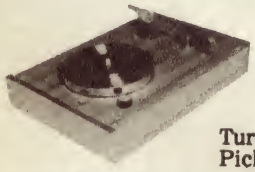
MIDLAND
1 WATT TRANSCEIVER

for 27,240KHz operation with switch provision for two additional channels, tone call signal, background noise squelch control, battery voltage indicator, steel case with separate cover, good for five miles distance communication under average field conditions, with penlite cell-batteries for

ONLY $37.50 PER UNIT, FULLY GUARANTEED.
Postage extra.

NEW IMPORTED STEREO TURNTABLE AND PICK-UP

240 VOLT AC OPERATION



3 speed turntable with ceramic stereo pickup counter-balanced tubular arm, **$7.90**. Base in teak or walnut, **$5.50** extra. De luxe base **$8.50** Post 50c or $1.00 with base. .

Turntable and motor separate .. **$4.50**
Pickup arm and cartridge **$3.50**

A TRANSISTOR PREAMP FOR MAGNETIC PICKUP OR TAPE HEAD

Using 2 transistors per channel, as featured in "Electronics Australia" (Sept. 1971). Complete kit includes transistors, PC board, resistors, capacitors.
Circuit and full details supplied.
Kit (not incl. box) **$7.90**
240V Power Supply **$4.50**
Metal box **$2.00** extra.
State if required for pickup or tape head.

BROADCAST TUNER KIT

$22.50

POST. 75c.

Complete kit of parts including dial mechanism and zener diode for this I.C. tuner as featured in Feb. E.A.

LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KHz to 390MHz. Provision for crystal.

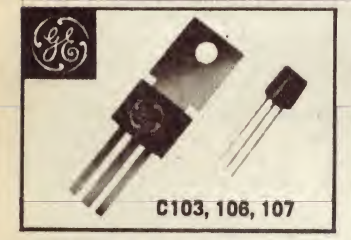
$49.50

Post N.S.W., 75c; Interstate, $1.25

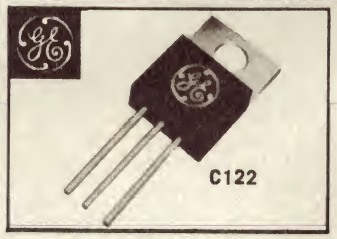
NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, NSW 2048 PHONE 56 7398

General Electric has an SCR or TRIAC in the price-performance range you need!

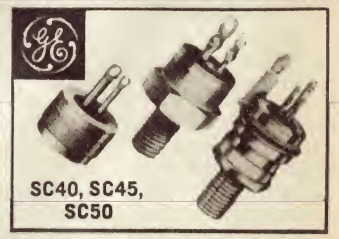


SILICONE ENCAPSULATED SCR'S PRICED FOR VOLUME APPLICATIONS. C103-.8A up to 200V in TO-18 configuration. C106 and 107-4A up to 400V in Power Tab packages. Millions already being used in sensing, controlling, amplifying, timing and switching applications.



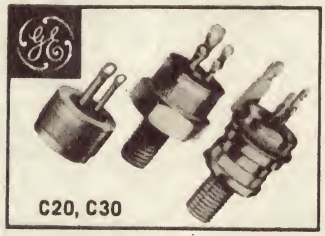
8A SCR with GLASSIVATED pellet in silicone encapsulated package featuring round leads and TO-66 interchangeability. Ratings up to 400V. Priced for volume automotive, consumer, and industrial applications. Designed for either printed circuit board or chassis mounting.

THE CLASSIC SCR backed by 13 years of design and field experience. 35A up to 800V. 125°C T_J max. TO-48 package outline. JEDEC Types 2N681-692. JAN and JANTX Types available.



6, 10 and 15A TRIACS up to 500V. Available in three packages. Inherent immunity from transient voltage damage. For industrial and consumer applications performing heat, light, speed and power switching functions.

HIGH SPEED INVERTER SCR's in GE's efficient PRESS-PAK. Amplifying gate construction for superior ratings. C397/398-700A rms up to 1200V. C387/388-550A rms up to 1200V. Designed for power switching up to 3 kHz sinusoidal.



INEXPENSIVE medium current SCR's for high volume industrial and consumer applications. C20-7.4A up to 400V. C30-25A up to 400V. High surge capability. Available in stud, isolated stud, or press-fit packages.

C600, 601, 602
2600V phase control SCR. Packaged in GE's efficient and reliable PRESS-PAK. Ideal for phase control of large motors.

C144
High power switching. 35A, 500-800V capability for rectangular and sine wave operation up to 10KHz.

C137
35A up to 1200V SCR. Operating temperature range -65° to 125°C, di/dt - 150A/usec when switching from 600V.

AUSTRALIAN GENERAL ELECTRIC LTD.

103 YORK STREET, SYDNEY 2000. PHONE: 29-8711

DISTRIBUTORS: NS Electronics. Sydney. Tel.: 476-1586. Melbourne. Tel.: 729-0731.
Watkin Wynne Pty. Ltd., 32 Falcon St., Crows Nest. Tel.: 43-2107
PB Components. Melbourne. Tel.: 53-2766.
H. Rowe & Co. Pty Ltd., Perth. Tel.: 28-5444.
GEC-Elliott Automation Pty. Ltd., Sydney. Tel.: 439-2107.
GEC-Elliott Automation Pty. Ltd., Adelaide. Tel.: 71-7971.
GEC-Elliott Automation Pty. Ltd., Brisbane. Tel.: 32-0441.
GEC-Elliott Automation Pty. Ltd., Melbourne. Tel.: 42-3961.

replaced by another, or taken out and altered in size.

So much, then, for the source of the RF carrier energy in our transmitter. But the output of the oscillator is seldom strong enough to be fed direct to the transmitting aerial. Usually, it must first be amplified by one or more valve or transistor stages in the RF amplifier, as we mentioned before.

An RF amplifier using a pentode valve is shown in Figure 8. It has a tuned circuit in both the grid and plate circuits, and both tuned circuits are made to resonate at the oscillator frequency. Other types of RF amplifier stage called "multipliers" have the plate circuit tuned to a multiple of the oscillator frequency, and the stage is arranged to multiply the frequency. This is used where the required carrier frequency cannot conveniently be generated directly by the oscillator.

For instance, multiplier-type RF amplifiers must be used with crystal-type RF oscillators if very high carrier frequencies are required, as it is impractical to make quartz crystals to oscillate at very high frequencies.

Link windings couple the tuned circuit of the RF oscillator to the input of the amplifier, in this case. If the RF oscillator used a crystal rather than an L-C tuned circuit, one of the other types of coupling would generally be used.

Negative bias is applied to the grid of the valve to ensure that it operates at a convenient point and amplifies efficiently. The amplified RF carrier which appears in the plate tuned circuit (the so-called "tank" circuit) is coupled to the next stage — or to the aerial if this is the last stage — via another coupling loop.

We have now seen something of those parts of a radio transmitter responsible for the generation of the RF carrier energy. By adding a Morse key to this, we would have a keyed-carrier or CW transmitter, but let us progress a little further and see how the carrier may be varied in strength so that it can be used to transmit voices, music, or even pictures. In other words, let us see how continuous amplitude modulation is performed.

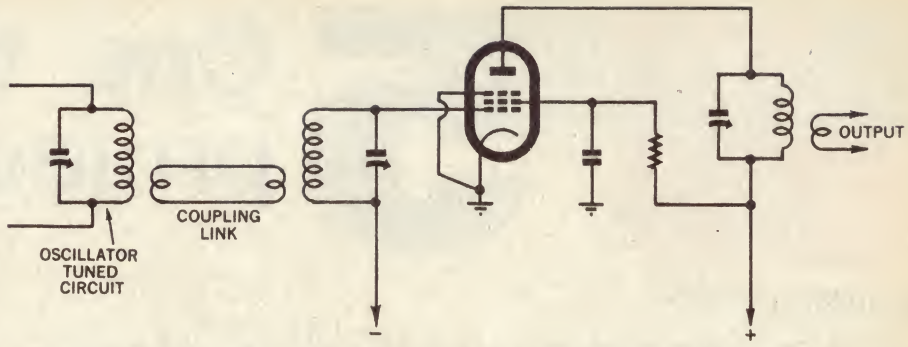
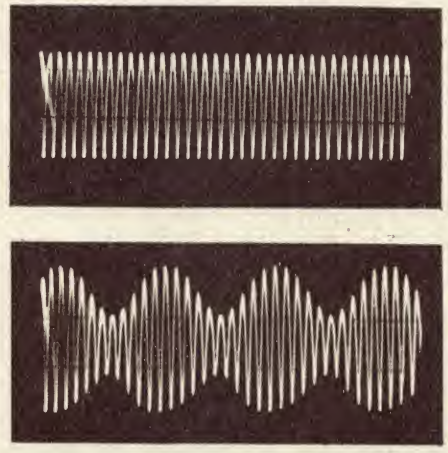


Figure 8: The basic form of an RF amplifier stage, using in this case a pentode valve. Transistors are also used for this purpose.



Two photographs taken from the screen of an oscilloscope, an instrument which allows us to "look at" electrical EMFs and currents. The upper pattern shows an alternating RF "carrier" signal, and the lower pattern the effect of modulation.

The strength of the RF carrier fed to the aerial depends on a number of things, but one of these is the supply voltage of the final RF amplifier stage. The output is, in fact, proportional to the plate voltage, with a circuit like that of figure 8.

Because of this, to vary the strength of the RF carrier — to amplitude modulate it — all that need be done is superimpose the audio (sound) frequency signals on the plate supply voltage. In this way the audio signals add to and subtract from the plate voltage, and vary the strength of the RF carrier in sympathy with the sound waves reaching the microphone.

There are other ways of amplitude modulating the carrier, but they all produce much the same effect and need not concern us here. The basic idea of a plate-modulated AM transmitter is shown in figure 9.

There is an RF oscillator and an RF amplifier, as with the CW transmitter, in order to generate the RF radiation energy. However, added to this section is the microphone, an audio amplifier (the "modulator") and a transformer used to superimpose the amplified audio frequency signals on to the plate voltage of the RF amplifier.

The audio amplifier may use either valves or transistors, and builds up the strength of the tiny voice-frequency voltages generated by the microphone. The output of the audio amplifier is fed to one winding of the modulation transformer.

The other winding of the transformer is connected in series with the plate circuit of the final RF amplifier, so that the amplifier receives its plate current through the transformer winding. In this way, the amplified alternating audio voltages induced in this winding of the transformer add to or subtract from the supply voltage, and can vary the strength of the carrier fed to the aerial.

The small waveform sketch shows what the modulated carrier would look like if we could see it. In fact, we can see it if we use an instrument called an oscilloscope, as the two photographs show.

Instead of the microphone, we can use a gramophone pickup, a tape recorder, and so on. In television transmission, we would use cameras, film scanning machines and video tape recorders instead.

And with the description of a basic AM transmitter, we must end this chapter. Now that we are reasonably familiar with the nature of radio waves and at least two of the ways in which information can be transmitted, we are ready to look at the way in which the radiated radio waves are used. In the next chapter, then, we will start at the "other end" of the radio system — the receiver.

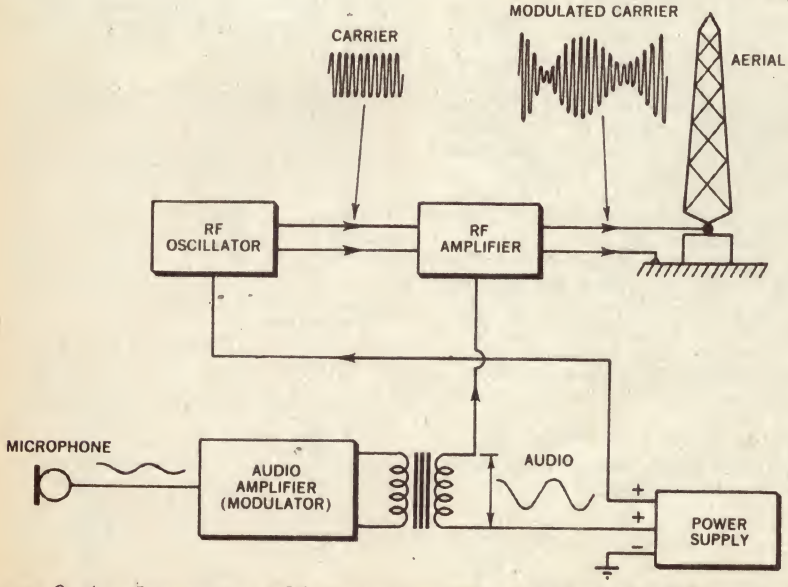


Figure 9: An elementary AM transmitter, showing how the RF signal is made to function as a "carrier" of the audio information.

Elementary Electronics

5 One transistor projects

by ROSS TESTER

The circuits below have one thing in common — they each work from only one transistor. And the transistor is the cheapest part — in fact, it is free.

By courtesy of Fairchild Australia Pty. Ltd., we are giving away 4000 transistors to our readers. This offer is especially intended for younger readers, but we are quite happy to give away a transistor to anyone who sends in the coupon on page 75.

Since our supply is limited, it is a good idea to post your coupon as soon as possible — and be sure to enclose a stamped, self-addressed envelope.

We designed these circuits around the free Fairchild transistors, but the coupon entitles you to only one transistor. So it is more than likely that many of our readers will want to obtain other types of transistors to build the other projects.

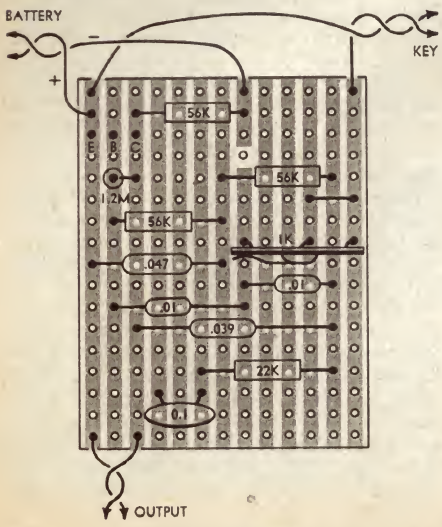
All of the circuits shown should work quite satisfactorily with the Fairchild 2N3638A transistor, which the free one is roughly similar to. Other types of PNP silicon transistors may also work.

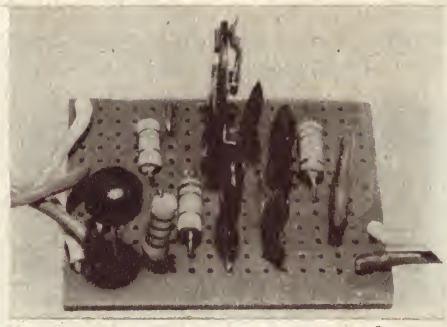
Code Oscillator

Have you ever listened to a short wave receiver and heard long strings of dots and dashes, and wondered what they meant?

The oscillator described here will help you learn the Morse code, if you have the patience to learn. By connecting a key to the circuit, you can "transmit" Morse to a friend, and he can do the same thing back to you. This way, you will be able to master the code.

There are four main requirements for a practice oscillator of this type. These are: It must be free from "clicks" and "chirps"; it must be stable in frequency; it must be easy or pleasant to listen to; and, preferably, the pitch should be variable.





Basic oscillator mounted on Veroboard.

Considering the simplicity of this circuit, the oscillator is surprisingly good in all these respects. There are no chirps (that is, a slight change in frequency as the key is pressed), very light key clicks, the tone is quite pleasant (not unlike a flute or clarinet), and the frequency is very stable over quite long periods.

Basically, the oscillator is a "twin T" network. It gets this name from the appearance of the two T-shaped networks which determine the oscillator's frequency. With the twin T, the frequency can be varied easily in one of two ways, by varying the capacitor at the junction of the two resistors, or by varying the resistance at the junction of the two capacitors.

We have chosen to vary the resistance, because this is the easiest to do. While it is possible to vary the capacitance by substituting individual fixed capacitors, this is not very practical. It is far easier to change the resistance by means of a variable resistor. If you wish, you could experiment with different values of resistors and capacitors in the legs of the "T" sections.

The variable resistor we used was a small preset potentiometer, but you could use an ordinary variable pot if you wished. The difference is that the preset pot may be mounted on the Veroboard with the other components, and adjusted with a screwdriver. The ordinary variable may be attached to connecting leads and is varied in the same way as a volume control on an amplifier.

By varying the pot, you will be able to change the pitch of the oscillator, to find the pitch which is most pleasant for you.

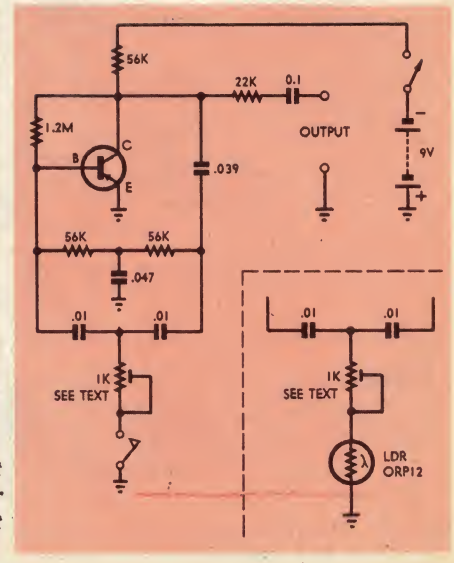
To use this oscillator, you will need to feed it into an amplifier, either into a "Pickup" or "Aux. Input" channel. Or you may care to construct a simple audio amplifier from one of those featured in the March, 1970 issue. (Reprint 1 / XA / 10.)

A code key is connected between the pot and the positive supply rail, and it is this key which is used to make your dots and dashes. We would suggest that you try to obtain a proper key (possibly from disposals sources) as a good key is of prime importance if you are to develop a good "hand" for sending Morse code.

The easiest way to mount the oscillator components is on a piece of Veroboard. If you follow the diagrams, there should be no problem. Note that there is a break in the copper pattern at one point. It is easy to do this with a ⅛in. twist drill. Simply hold the drill in your hand, put the point into the hole to be broken, and turn the drill a couple of times. This will cleanly break the copper pattern around the hole.

When soldering components, especially transistors and diodes, take care that you do not overheat components. It is best to "pre-tin" the components before soldering them to Veroboard. Be sure to use a heat sink (such as a pair of pliers) on the leads to prevent heat damage when soldering.

We do have another couple of uses for the code oscillator. The next project shows you how to modify it slightly, but another idea, which we are still working on, will be presented soon — possibly next month. We think you will find our new ideas interesting, so when you have finished experimenting with the oscillator, don't pull it to pieces — wait and see what else you can do with it.



At left is oscillator component layout; at right is code oscillator circuit with substitute LDR circuit for light control.

Light Controlled Oscillator

The code oscillator circuit can be quite easily modified to make the oscillator light controlled. In other words, the oscillator will not function without light, but when light is present, will vary its pitch according to the intensity of light.

To make the oscillator light sensitive, all we do is remove the key and substitute a light dependent resistor (LDR).

The resistance of an LDR varies in proportion to the amount of light striking it. This resistance varies, typically, from tens of megohms in complete darkness down to a few hundred ohms in very bright light.

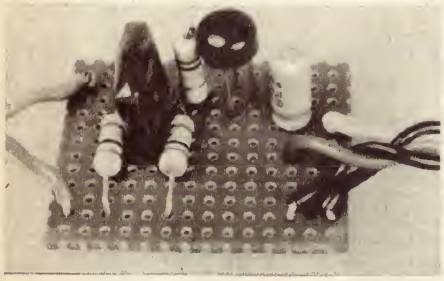
In low light the LDR resistance is too high for the oscillator to function. Once the light increases, however, the resistance lowers, and the oscillator will turn on. More light will cause the tone of the oscillator to increase in pitch — and vice versa.

By waving your hands above the LDR (and hence interrupting the light) the oscillator pitch will vary, not unlike the weird "space music" one often hears in TV science fiction.

What can one use a light sensitive oscillator for?

One use which we can immediately think of for such a device as this is for a party game — trying to find a candle or light bulb in a darkened room while blindfolded. Armed with this oscillator connected to a small amplifier, all one would need to do is to walk around the room a few times, holding the LDR in front of you. As you approach the light, the oscillator would lessen in pitch, but if you turned away, it would stop altogether. It shouldn't take too long to find the light source.

Impedance Matching Stage



Impedance matching stage mounted on Veroboard.

In audio work, a problem which faces some of us from time to time is the matching of a high impedance source to a lower impedance input. The "emitter follower" circuit described here will help match these different impedances.

Some possible uses for a circuit such as this include: matching a high impedance

"it sounds really real"

with BASF LH-hifi recording tape

Initially, the objective of all recording equipment is to translate the transient vibration patterns which are "sound," into a permanent form.
The ultimate objective is to reproduce them in an audible form once again so that they are "really real" compared with the original.
This ultimate objective is one step closer with **BASF LH-hifi recording tape.** L stands for low noise . . . H is short for high output. By eliminating the background noise, and increasing sensitivity, BASF engineers have achieved a dramatic improvement in signal-to-noise ratio of as much as 8dB over other quality tapes.

Now your recordings will take on magnificent studio quality—with greater clarity, more realism and less distortion—whether they be Beethoven symphonies or recorded birthday messages.

BASF LH-hifi tapes also available in Compact Cassettes.

Playing times:

C30	=	2	x	15	minutes	=	30	minutes.
C60	=	2	x	30	minutes	=	60	minutes.
C90	=	2	x	45	minutes	=	90	minutes.
C120	=	2	x	60	minutes	=	120	minutes.

BASF Compact Cassettes available everywhere in your choice of either "Trans," "Snap" or "Plastic Pack."

BASF HAS THE QUALITY—YOU MAKE THE MUSIC—BASF FOR ENDLESS PLEASURE

BASF

Australian Distributors:
Maurice Chapman & Company Pty. Ltd.,
276 Castlereagh St., Sydney. Phone: 61 9881.
146 Burwood Rd., Hawthorn, Vic. Phone: 81 0574.

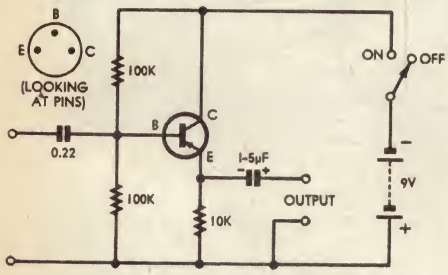
BA1371B

microphone to an amplifier with a lower impedance input; feeding a microphone signal into a long length of cable so that the high frequency component of the signal will not be attenuated by the capacitance of the cable; and coupling a piece of equipment with a high impedance output (such as a tape recorder) to a low impedance input on an amplifier.

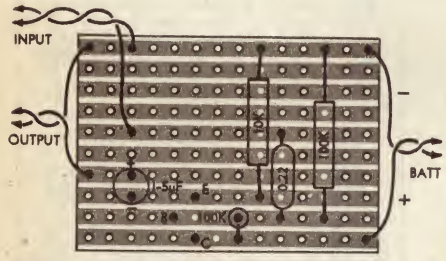
The input impedance of this circuit would be approximately 50K, for all load input impedances of about 5K or over. Most amplifier inputs would fall into this category.

You may wonder why we have called the circuit an "emitter follower". It is given this name because the waveform at the output (the emitter) follows the waveform at the input. The circuit does not invert the signal, as other types of circuits do.

The voltage gain of this circuit is less than unity (we get less signal voltage out than we put in) but this does not mean that the transistor is not amplifying the signal. What it does mean is that we are using the amplification to achieve another purpose; a change in impedance. Instead of a voltage



Circuit for impedance matching stage.



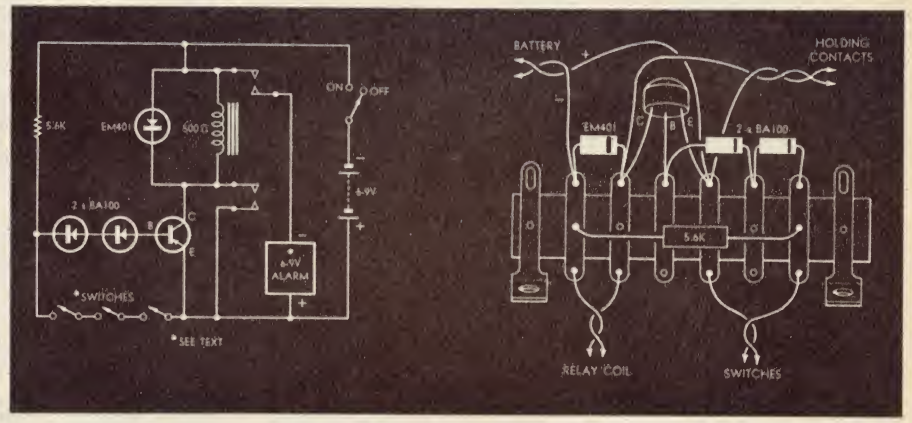
Wiring layout for impedance matching stage.

increase, we accept a slight voltage decrease, but across a very much lower impedance. This, in fact, represents a form of amplification — power amplification.

Therefore, there must be a sufficiently high level of signal available from the source to ignore the lack of gain. The signal is applied to the base via a 0.22uF capacitor, and extracted via a low value electrolytic. We used a 1uF, but anything up to about 5uF would suffice.

Layout is not critical. We have built it up on a piece of scrap Veroboard, but it could be built on tagstrips if you so desire.

Follow our diagrams, and you should have no trouble duplicating the prototype. To check that the circuit is operating correctly place a multimeter in series with the supply battery — taking care of the polarity of the meter. The circuit should draw approximately 0.4-0.5mA if it is operating properly.



Circuit for burglar alarm.

Wiring layout for burglar alarm.

Burglar Alarm

This burglar alarm circuit, while very simple, is extremely reliable and economical. You can protect your home and property against intruders with a device such as this — and the circuit described here, in its simplest form, will cost you less than two dollars — (even less if you can "scrounge" an old relay).

The circuit is simple. The door and window switches bias the transistor "off" while they are closed. But as soon as one or more of these switches is opened, the transistor is biased "on", and the relay is energised. This closes the relay contacts and starts the alarm.

Note that one set of contacts (known as "holding" contacts) bypass the transistor and hold the relay on, even if the switch is closed and the transistor is turned off. This will keep the alarm on until someone investigates and turns it off, and would also discourage the intruder from having another try.

Until the alarm operates, the circuit draws very little current. From Ohm's law we can work out that nine volts across a 5.6K resistor involves a current flow of only 1.6 milliamps. (There should be no appreciable leakage through the transistor and relay). So the life of the battery should almost be equal to its "shelf life".

Naturally, the alarm itself will draw a far greater current — particularly if it is a large bell, for example. So you might give consideration to using a separate power source for the alarm. This could be a much larger battery, possibly re-chargeable, which would be sure of making the "alarm" function reliable at all times.

Note that if you do use another battery, you should not connect the alarm contacts on the relay to the circuit battery, as we have shown. Instead, you should use the contacts as a switch in the external circuit.

The relay you use should have a coil resistance of approximately 500 ohms. This is the value we used. although slightly lower and higher coil resistances should work. Do not use a relay with too high a resistance, however, as the relay will not energise, or one with too low a resistance, which may endanger the transistor by allowing too heavy a current to flow through it.

The relay should have at least two sets of normally open contacts. And, depending on the current drawn by your alarm, these contacts may have to be quite large. If there are more than two sets of contacts on your relay, some may be wired in parallel to give a higher current-handling capability.

The EM401 diode in parallel with the relay coil is used to suppress transient voltages generated when the coil circuit is opened. You may remember from the article on the electromagnet in the November, 1971 issue that a collapsing magnetic field generates

BUY DIRECT BY MAIL & SAVE AT LEAST ⅓!

AUSTRALIA'S LEADING MAIL ORDER TAPE & ACCESSORY SPECIALISTS

BRAND 5 CASSETTES FULLY IMPORTED FROM U.S.A.

CASH BACK IF NOT SATISFIED

LESS THAN HALF THE PRICE OF OTHER IMPORTED TAPES!

C60 Normal Price $1.50, our price **99c**
C90 Normal Price $2.25, our price $1.65
C120 Normal Price $4.75, our price $2.25

Send your order today to:

DIRECT TAPE DISTRIBUTORS
BOX 3040 G.P.O. SYDNEY. 2001

ORDER 12 CASSETTES
(mixed if you wish)
and get this beautiful cassette case—holds 12 Cassettes . . . **FREE!** (WORTH $3.50)

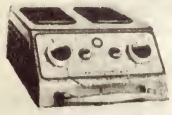
SEND THIS COUPON TODAY

Enclose cheque only for the 12 tapes in sizes required.

NAME:.....

ADDRESS:.....

.....



New All Silicon 30 / 60W PA PORTABLE AMPLIFIER

12-16V, two inputs, 5mV and 100mV. Dimensions 6½in W x 3¼in H x 8½in D. 15-ohm output, No 763D, $62. For 125, 250, 500-ohm output, No 763A, $64. For 240V operation $33 extra.
10W PA amplifier similar to above, 4-ohm output, 240V operation, No 729D, $40. Freight extra.

CD IGNITION COIL

For EA (Fraser) circuit. Mounted on strong fibreglass printed circuit coded for all other components. Polyester film layer insulation. Connected and tested. For standard distributor, No 787; for photo cell distributor, No 786. $8 each. Postage 20c each.

R.C.S. COMPLETE DO-IT-YOURSELF KITS

Peak reception. Low price. No expensive test equipment. Everything fits. 1964 RF Transports 7.

Complete kit — No 640 $43.50
Portable car radio. Identical to 640 above, plus extra switch and car coil, etc. No. 642 $46.00
Postage $1.
(Write for booklet on 640 and 642.)

NEW TRANSISTOR PREAMP KIT

SIZE 3 x 2 x 1in, 2 req. for stereo.

LOW IMP input, 2 trans, 672C	$6.50
Wired ready for use, 672D	$8.00
HIGH IMP, 2 trans, 680C	$6.50
Wired ready for use, 680D	$8.00
HIGH IMP silicon, 3 trans, 682C	$8.00
Wired ready for use, 682D	$9.50

Postage 10c each. Write for data.

COILS and IFs 455KHz

Aerial, RF, Osc and IFs	$2.00
Ferrite aerial	$2.40
No. 265 Universal tape Osc coil	$6.00

Postage 10c. Write for details and price.

HI-FI BROADCAST TUNER UNIT
4 TRANSISTORS—HIGH SENSITIVITY

RF mixer, IF, power detector stages, adjustable aerial coupling. Complete as illust, wired and tested with 461 dial, knobs and switch pot, No. 474D, $31. Freight extra.
WHISTLE FILTER for above set for 8KHz bandwidth. (Can be altered to 9, 10 or 11KHz.) No. 128, $4. Post 10c.

10W STEREO
MULLARD
10 + 10W RMS

With output transistor PROTECTION. Frequency response 40Hz to 30KHz. Distortion 0.5 per cent. Treble, bass boost, 20dB.

Complete kit of parts, No. 480C	$74.00
Wired and tested, No. 408D	$79.00
Cabinet as illustrated	extra $10.00
Magnetic pickup preamp, No. 762D	extra $11.50
Inbuilt BC tuner with w/ filter	extra $35.00

Plus freight. Write for brochure. For special Saturday demo, ring 59 6550.

R & H and EA PRINTED CIRCUITS

Clearly coded for easy assembly. With blueprint parts list. Immediate dispatch.. Add 20c postage for each. Specials to your drawings — write for particulars and drafting aids.

767—70.B.F.08, 777—70.F.10, 788—71.D.3, 772—70.G.7 — $2.00 ea.
563—64.M.7, 579—64.A.8, 683—64.A.9, 678—65.O.9, 679—65.M.9, 684—65.P.10, 685—65.P.12A, 769—70.K.60, 686—65.P.12B, 694—66.R.2, 704—67.P.2, 707—67.P.3, 708—67.A.3, 709—67.P.4, 711—67.A.4, 723—68.S.T, 731—68.M.12, 736—69.S.T, 750—70.A.1, 756—70.R.1, 758—10.P.1, 778—70.T.X.2, 792—E.T.003 — $2.50 ea.

726—68.A.8, 759—70.C.1, 776—70.A.2 — $2.80, $2.80, $4.00
717—68. P.1, 741—69.P.5, 747—69.C.10, 746—69.P.9, 639—65.T.3, 727—68.8.T, 728—68.O.9 — $3.00 ea. $3.20 ea.

SPECIALS

734—59.O.1, 738—58.S.3, 740—68.10.CL, 74Z—69.C.9, 748—69.D.10, 754—69.C.11, 749—69.C.12, 751—70.TX.1 — $5.00 ea. nett

TRANSFORMER

Tap 6V and 9V at 100mA. Filter capacitors, rectifier, resistor, etc. $6.50. Post 20c.

NEW STEREO MAGNETIC PREAMP

Hum free, 5mV input, 250mV out. Size 3 in x 2in x 1in. Wired ready for use. No. 762D. $11.50. Post 10c.

NOISE FILTER
for radio and TV

No. 27 line filter, 2A	$8.50
No. 29, 10A. No. 29B, 20A line filter	$35
No. 30 pulse filter, 2A	$11.50
No. 11 aerial filter	$13

Order direct. Pack and post 50c.

MAGNETIC STEREO PRE+AMP

In 5mV, out 250mV. Bass and treble 20dB.

No. 724C	$29
Wired ready for use	$31

Postage 30c each.
For crystal, ceramic, No. 722D $27

NEW BASS BOOST
4-TRANSISTOR STEREO AMP

Unity Gain:
400Hz, 0dB
100Hz, 5dB
50Hz, 9dB
30Hz, 14dB

Connect between your preamp and main amp. No. 791D, $10.80.
Postage 20c.

LATEST PRINTED CIRCUITS

779—70.R.D.1	$3.00
780—70.P.A.1	$3.00
790—70.H.P.1	$3.00
783—71.T.U.2	$2.00
766—773—789—71.R.1	$2 ea.
796—71.S.A.4.A	$2.50
797—71.S.A.4.B	$2.50
798—71.S.A.4.C	$3.00
770—71.A.8	$2.50
812-71.P.8	$2.50

R.C.S. Order by Mail Order. Postal Note or Money Order (add post) direct to —
RADIO PTY. LTD., 651 FOREST ROAD, BEXLEY, N.S.W. 2207. 587 3491

quite high transient voltages in the coil — high enough, in fact, to destroy the transistor were it not for this diode.

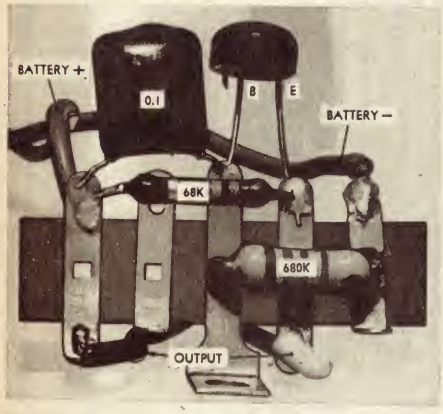
The two BA100 diodes in series effectively increase the reverse base-emitter breakdown voltage of the transistor. This is more or less for the same reason as the other diode — only this time it is used to protect against transient voltages generated by the bell or buzzer used as the alarm itself.

The buzzer or bell used as the alarm device can take many forms. It may be a large bell mounted on the wall of the house, or a small buzzer or bell to give warning to a specific person. A localised "quiet" warning has one decided advantage — the first the intruder knows about the burglar alarm could be when the gentleman in blue taps him on the shoulder!

Or you may like to use a device such as the solid state "Sonalert", marketed by Plessey Ducon Pty. Ltd. This little device gives a loud whistle, but draws only a few milliamps of current. The cost of this device is about six dollars. If you do use something like this, take care with the polarity. We have marked a plus and minus on the circuit for this purpose. Ordinary bells and buzzers are not polarised.

The choice of door and window switches is largely left up to you. However, we would consider a "dry reed" switch and associated magnet to be one of the best types of switch. For a full article on actually installing a burglar alarm in your home, the one we published in September, 1967, will give you all the information you should need. Copies of this article are available through the information service for fifty cents (reprint 3 / MS / 14).

White Noise Generator



Wiring layout of white noise generator mounted on a tagstrip.

Our last circuit is rather a novel one. You will notice that only two connections to the transistor are made. In other words, we are using the device not as a transistor, but as a diode. Also, you may notice that the connections to the diode are reverse to what one would normally expect for a PNP transistor. Therefore, we are using a reverse-biased base-emitter junction. Why?

(Continued on page 125)

ALL PRICES INCLUDE TAX AND POSTAGE

IMPORTED COMPONENTS

P.O. BOX 1683P, MELBOURNE 3001

1N645	.84
1N914	.51
IN3491 + R	1.75
IN3492 + R	1.83
1N3493 + R	2.36
1N3660 + R	1.99
2N174	6.09
2N217	1.24
2N277	2.32
2N301	2.66
2N301A	3.84
2N384	2.88
2N404	.78
2N406	1.01
2N417	1.77
2N441	1.80
2N443	3.22
2N456A	4.20
2N489B	14.76
2N591	2.20
2N649	2.12
2N696	1.13
2N697	1.17
2N706A	1.08
2N930	1.80
2N1038	3.92
2N1046	17.94
2N1073B	7.59
2N1302	1.01
2N1303	1.01
2N1305	1.13
2N1306	1.32
2N1307	1.32
2N1308	1.64
2N1309	1.64
2N1546	5.85
2N1639	1.20
2N1908	27.74
2N2102	2.78
2N2147	3.60
2N2148	3.60
2N2160	2.40
2N2188	2.79
2N2270	2.40
2N2646	2.19
2N2647	3.15
2N2669	6.53
2N2926	2.25
2N3005	5.32
2N3054	1.80
2N3525	3.70
2N3563	.90
2N3564	1.08
2N3565	.86
2N3566	1.01
2N3567	1.08
2N3691	.86
2N3692	.90
2N3694	.90
2N3702	1.01
2N3703	.96
2N3704	1.77
2N3705	1.73
2N3706	1.65
2N3707	1.14
2N3708	.80
2N3716	5.30
2N3731	3.17
2N3790	11.25
2N3819	1.77
2N3826	1.68
2N4121	1.04
2N4250	1.17
2N4354	1.28
2N4355	1.65
2N4356	1.65
2N4360	1.58
2SB186	1.50
2SB407	3.30
2SB474	3.30
2SD150	1.50
2SF28	5.60
3N140	2.55
3N141	2.34
AA119	.36
AB1101	1.20
AB1102	.87
AC107	2.28
AC125	.96
AC126	.96
AC187 / 188	2.36
AC128	1.05
AC132	1.01
AC172	1.20
AC187188	2.36
AD149	2.45
AD161 / 162	4.32
AN1102	.68
AN1103	.60
AN1104	.60
AN1105	.60
AN2001	.45
AN7102	.90
AN7105	.68
AS147	.80
AS148	.76
AS208	1.46
AS301	.81
AS306	.84
AS307	.84
AS308	.84
AS310	.99
AS311	.96
AS312	.93
AS313	.92
ASY73	2.12
ASY76	2.10
ASY77	1.68
AS216	3.03
AS217	2.59
AS218	2.91
AS220	.98
AS221	2.16
AT316	.68
AT318	.68
AT319	.69
AT321	.69
AT322	.63
AT323	.68
AT324	.68
AT325	.83
AT331	.92
AT337	.69
AT338	.70
AT341	.70
AT350	1.14
AT1138	2.66
AX1101	1.53
AX1103	1.70
AX1104	1.86
AX1108	1.86
AX1127	1.50
AX1130	1.50
AX1131	1.77
AX1132	1.50
AX1142	1.20
AX1143	1.58
AX1144	1.44
AX1166	1.37
AX6168	1.98
AY1102	1.04
AY1108	1.65
AY1113	.69
AY1119	.60
AY6108	1.65
AY6109	1.65
AY8108(8103)	3.75
AY8109(8104)	3.00
AY8112	6.75
AY8135	5.40
BA100	.44
BA102	1.46
BA114	.39
BC107	.83
BC108	.76
BC109	.91
BC147	.76
BC148	.68
BC149	.79
BC157	.89
BC158	.76
BC159	.89
BC177	.91
BC178	.84
BC179	.92
BC186	.79
BC207	.72
BC208	.63
BC209	.75
BCY10	2.59
BCY11	3.24
BCY12	3.14
BCY39	5.19
BCY71	2.05
BCZ210	1.95
BCZ211	2.37
BCZ212	2.16
BD139	3.67
BD140	3.90
BDY20	2.63
BDY38+	2.62
BF115	.87
BF145	.64
BF173	1.14
BF177	1.63
BF178	1.80
BF179	2.04
BF184	.72
BF185	.72
BF194	.67
BF200	1.32
BFY51	5.19
BSX19	2.16
BSX20	2.39
BT100A / 500R	3.00
BT101 / 500	5.40
BTY79 / 100R	2.70
BTY79 / 300R	3.45
BTY79 / 500R	5.19
BY127 / 800	78
BYX21L / 200R	1.35
BYX38 / 300 + R	1.32
BYX38 / 600 + R	1.62
BYX38 / 900 + R	2.08
BYX38 / 1200 + R	3.03
BYX39 / 600 + R	3.14
BYX39 / 800 + R	3.88
BYX39 / 1000 + R	4.53
B2X70Scvies	1.95
B2Y88C303toC11	.83
B2Y88C12toC30	.98
BZY95 Scvies	2.16
BZY96 Scvies	2.16
BZZ15to29	2.37
C20D+	6.60
C106 / Y1	2.10
C122D	3.78
D13TI	1.95
DTG110B	6.96
DTG1010	15.16
EM402	.45
EM408	.80
EM410	1.40
FLV100	3.30
FPT100	1.80
H35	8.07
MB1	2.03
MB3	2.65
MB6	3.40
MB8	4.30
MJE2955	4.55
MJE3055	3.06
MPF104(Fet)	1.10
OA5	0.65
OA10	0.87
OA47	0.65
OA90	0.32
OA91	0.33
OA95	0.39
OA202	0.75
OC20	6.38
OC22	3.03
OC23	3.80
OC24	3.45
OC44N	1.11
OC45N	1.11
OC74N	0.96
OC140	1.95
OC141	2.60
OC201	3.80
OC202	3.70
OCP70	2.60
OCP71	4.32
ORP12	0.95
ORP60	1.75
PA40	4.83
PB40	7.26
SC45D	11.10
SC50D	13.00
SC146D	3.70
SE2001	0.98
SE2002	1.20
SE3001	1.12
SE5001	2.10
SE5002	2.10
SE5003	2.48
SE5020	4.05
SE5023	3.15
SE5025	1.35
ST2	1.50
T1 / 40 / A2	3.30
T13027	2.61
TIC44	1.68
TIC45	1.88
TIC46	2.05
TIC47	2.30
TIP31A	2.10
TIP32A	2.70
TIP33A	2.98
TIS34	2.46
TIS43	2.36
ZD Series	1.98
40360	2.48
40361	2.70
40407	2.52
40408	2.98
40409	3.15
40410	3.30
40411	9.70
40669	3.50
FETS	
2N4889	2.70
2N5245	2.62
2N5459	1.77
2N5485	1.77
MPF102	1.00
I.C.'S	
FUL709	1.75
FUL723	3.95
FUL739	5.10
FUL900	1.20
FUL914	1.20
LM370	6.75
LM372	5.62
MC1303	5.20
PA246	13.60
TAA300	4.32

SPECIALS

AY1101	.31 ea.
AY1103	.51
AY1104	.41
AY1110	1.03
AY1112	.57
AY1115	.45
AY1116	.45
AY1117	.45
AY1120	.63
AY1121	.63
AY8110	2.55
AY8111	2.55
SE1001	.31
SE1002	.52
SE1010	.57
SE4001	.44
SE4002	.51
SE4010	.58
SE7001	2.76
2N3053	1.53
2N3055	1.26
2N3568	.63
2N3569	.57
2N3638	.56
2N3638A	.71
2N3640	.93
2N3641	.57
2N3642	.77
2N3643	.71
2N3644	.77
2N3645	.96
2N3646	.69
2N3693	.31
EM404	.22

CLASSICAL RECORDINGS

Reviewed by Julian Russell

Tchaikovsky's First — "well worth investigating"

TCHAIKOVSKY—Symphony No. 1 in G Minor (Winter Dreams). New York Philharmonic conducted by Leonard Bernstein. CBS Stereo SBR235426.

One would be right in thinking Tchaikovsky and Bernstein compatible temperamentally. Emotional volatility characterises both. Tchaikovsky marked the first movement of his symphony Allegro Tranquillo and added as its sub-title, Reveries of a Winter Journey. If Bernstein's reading is not always as strictly tranquil as the composer obviously intended it nevertheless succeeds in evoking the atmosphere that must have inspired the composer.

I found the high strings a bit wiry but a high frequency cut removed their cutting edge, so to speak, without any malign effect on the rest of the orchestra. This wiriness is not helped by Tchaikovsky's writing for strings. All his life he allotted them passages in which he seemed to wring passages from the instruments. Seldom do they sound as if they lie under the fingers, as do Wagner's. But there is, in this movement, an accompanying figure in the lower strings that is memorable for its beautifully rhythmic treatment. Despite the ardour that sometimes intrudes, Bernstein makes it all sound suitably bleak.

The slow movement is sub-titled Land of Desolation, Land of Mists. Unlike similarly inspired movements by Sibelius, whose landscapes are seldom peopled, in this of Tchaikovsky you can sense the presence of humanity.

I always think the second subject of this movement is just about as trite as could be. The melodic refinements of the later Tchaikovsky had not yet emerged in this early work. Bernstein does his fine best with this, resisting temptation to blow it up and preserving an almost serene climate. There is a wonderful passage for horns and the playing of the orchestra is supremely good.

There is nothing very original about the Scherzo except the syncopation of the first subject. There is much over-use of the chord of the diminished seventh, not uncommon at this period (1866). Then comes a waltz tune in the Trio, as luscious as any you'd find in Tchaikovsky's late ballets. Bernstein keeps it all nicely scaled down without any attempt to Stokowskyise it. There is an Andante Lugubre intro to the Finale — and very lugubrious it is, too. There is seldom anything more tragic than the doubts of a young man, whatever their reason. Youth is the age of hope. And this does emerge triumphantly later out of the despair of the intro, though admittedly Tchaikovsky pulls himself out of it with some desperation — and not always entirely convincingly. The different mood always sounds a little contrived, like the fugal passage that heralds the change. They mood of despair returns, even darker than before and again Tchaikovsky conquers it though not with the expertise he was later to develop in The Pathetique. But in the coda you will hear an unmistakable forecast of the excitement he was able to engender later. This is one of the composer's least hackneyed symphonies and well worth investigation by all who love his work.

★ ★ ★

BORODIN — Symphony No. 1 in E Flat Major. Moscow Radio Symphony Orchestra conducted by Gennady Rozhdestvensky.

LIADOV — From the Book of Revelations. From Days of Old. A Musical Snuff-Box. USSR Symphony Orchestra conducted by Yevgeny Svetlanov. HMV / Melodiya Stereo ASD2689.

Borodin's First Symphony, revised in turn by Rimsky-Korsakoff and Glazounov, is an attractive work very nationalistic in character according to the best tenets of Balakirev. The first movement all flows nicely — and naturally — without the fits and starts of the first movement of the B Minor Symphony. Missing however is that quite wonderful chord which Borodin used to modulate straight from the first movement of the B Minor into the remote key of the next movement. Here the second movement starts without any such inspired transition, but it's a brilliant Scherzo that follows, full of vigour and ingeniously scored, through some of the credit for this must surely go to the editors. Perhaps because it is new to me I prefer it to the Scherzo in the second symphony. It is in "Beethoven" form with a slow Trio following a fast theme in the manner of the Eroica Scherzo, though it is quite unlike that music in any other particular.

The slow movement is pleasing in its triste, Slavic way and you have a good energetic Finale without perhaps the originality Borodin displays in the previous movements.

With the exception of the Musical Snuff-Box the Liadov pieces were also new to me. From the Book of Revelations is a musical picture of Verses of Chapter 10 of that Biblical curiosity. You have first an admonishing intro, then some mystical passages, then some high chords usually associated with heavenly visions. Some of the following music expresses — I think — awe relieved by a comforting chorale-like tune in the Russian manner. I found its chief interest in its gorgeous — and extremely complex — scoring.

From Days of Old starts very ordinarily. It is roughly speaking in Ballade form, written originally for the piano and scored for orchestra by the composer himself later, with some important revisions, and additions. Those who know the composer's ballet suite, Russian Tales, will immediately recognise music from the same pen. It bears an inscription from the Epic of Igor's Army (12th century) and runs a brief, warlike course. The always elegant Musical Snuff-Box is played just about as elegantly as anyone could imagine. The sound is consistently first rate throughout this disc full of goodies for those — and I am one — who still respond to the music of the Russian Nationalistic School.

★ ★ ★

GRIEG—Piano Concerto in A Minor.

LISZT—Hungarian Fantasia.

FRANCK—Symphonic Variations for Piano and Orchestra. Gyorgy Cziffra, piano; Budapest Symphony Orchestra and L.Orchestre de Paris conducted by Gyorgy Cziffra Jnr., His Master's Voice (EMI) Stereo OASD7559.

In the first movement of the Grieg concerto, the prolonged, melodramatic pause after the short introductory piano bars made me think that the playing had stopped altogether. In the first movement proper there is much languishing over the slow bits, wringing every last bit of schmaltz out of the score. Yet Cziffra is not quite as showy — or vulgar — as he can be when he's really trying.

His son conducts very competently indeed and perhaps under papa's instructions, does his own wallowing in the slow bits. Cziffra's reading smacks much too much of that of an old time cinema organist. And if you think that father and son did an inexcusable amount of wallowing in the first movement, wait until you hear the second. In the Finale Cziffra again demonstrates the immensity of his technique and offers what is the best playing in the work.

Not surprisingly Liszt's Hungarian Fantasia responds best to Cziffra's untrammelled exuberance. There are some exaggerations, but these are suited to the rhapsodical atmosphere of the writing and Cziffra obviously enjoys every mouthful of this fiery goulash. But even here the last part goes so fast that it sounds like a comic caricature of the music, bearable perhaps at a circus but nowhere else. It is only too reminiscent of Sousa's Stars and Stripes played by the US Marines' Band.

TANDBERG

simply offers you sound reproduction indistinguishable from the original

No ***more*** and no ***less.*** Just an accurate encore performance. Of course TANDBERG quality means greater long term reliability, more long term performance and greater long term satisfaction; these attributes go hand in hand with the TANDBERG name.

You may choose a TANDBERG stereo deck or a TANDBERG self contained stereo system. The Model 3000X stereo tape deck is worthy of the finest stereo amplifiers and the most sophisticated speaker systems; the all new Model 4000X stereo sound centre incorporates twin 10 watts R.M.S. stereo amplifiers, built-in wide range speakers and an input sensitivity of 1.5 mV. for magnetic cartridges as well as a host of other highly desirable and effective features. This versatile recorder can be the "heart" of your new stereo system!

Both TANDBERG models employ the proven TANDBERG Crossfield Head which, in lay terms, provides ***wider frequency response,*** a far ***better signal-to-noise specification*** and ***more natural sound reproduction.***

See and hear both TANDBERG models at all franchised Simon Gray dealers. ***Listen and compare.*** TANDBERG superiority is clearly evident when you hear a demonstration, when you install your own TANDBERG . . . and years later, after hundreds of hours of musical pleasure.
Move up to TANDBERG!

Telex — 31904.
Simon Gray Pty. Ltd.,
28 Elizabeth Street,
Melbourne 3000.
Please send me full technical information about the TANDBERG 3000X/4000X (strike out model not required) and the name of my nearest Simon Gray franchised dealer.

NAME.....

ADDRESS.....

.....POSTCODE.....

EA TB 571

TANDBERG MODEL 3000X.

TANDBERG MODEL 4000X.

ABRIDGED SPECIFICATIONS:

TANDBERG MODEL 3000X.
Stereo tape deck.
• Three speeds — 7½, 3¾ and 1⅞ i.p.s. • Frequency response at 7½ i.p.s. = 40-20,000 Hz. • Signal to noise —60 dB. • Twin VU meters • Inputs for tuners, pickups, microphones • Wow and flutter: 0.07% • 4 sound heads • Sound on Sound • All solid state • All desirable controls

TANDBERG MODEL 4000X.
Complete stereo system.
• Three speeds — 7½, 3¾ and 1⅞ i.p.s. • Frequency response at 7½ i.p.s. = 40-20,000 Hz. • Signal to noise —60 dB. • Twin VU meters • Inputs for tuners, pickups, microphones • Wow and flutter: 0.07% • 4 sound heads • Sound on Sound • All solid state • Twin 10 watts R.M.S. amplifiers

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101 * Telex: 31904
Sydney Office: 53 Victoria Ave., Chatswood, N.S.W. Tel. 40 4522*
Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 6526
Adelaide Office: 301 South Terrace, S.A. Tel. 23 6219

INTERSTATE REPRESENTATIVES:

N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801
Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. 58 1422
Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel. 2 5322
W.A.: Athol M. Hill Pty. Ltd., 613-615 Wellington Street, Perth. Tel. 21 7861

Franck's Symphonic Variations are also presented with a coarse grain whenever the occasion offers, mercifully less frequently. There are all Cziffra's characteristic hesitations and drawn out, facile sentimentality. Father and son indulge in a tasteless rape of the wretched Franck.

★ ★ ★

SHOSTAKOVITCH — Symphony No. 14. Margarita Miroshnikova (soprano), Yevgeny Vladimirov (bass) and the Moscow Chamber Orchestra conducted by Rudolf Barshai. HMV / Melodiya Stereo ASD2633.

This unusual symphony dates from 1969 and again affirms Shostakovitch's position as Russia's leading composer and the world's greatest present-day symphonist. It is in the form of a song cycle for soprano and bass with an orchestra consisting only of strings and tuned percussion without timpani. Four poets — Lorca, Apollinaire, Rilke and Kuchelbecker — supply texts, all of which dwell on the subject of death. Yet despite the persistence of this mood there is no lack of variety in the music. Some of the accompaniments are complex and produce sounds of astonishing richness despite the spareness of the medium. (It is perhaps significant that the symphony is dedicated to Benjamin Britten.) Other accompaniments consist only of a counter melody on a single instrument played against the vocal line.

Death is contemplated from every aspect — sombre, bravado, challenging — and all are eloquent. Although there is nothing new in using a song sequence as the basis of a symphony — Britten's Spring Symphony and Mahler's Song of the Earth come immediately to mind — this work resembles no other. It is a highly individual statement by a great composer, at once deeply felt and perfectly wrought. There is not the space available here to describe each of the poems and its setting but all are assembled in a way to make an impressive symphonic whole of impressive dimensions. There are passages as exciting as any Shostakovitch ever wrote, others of an emotional depth I cannot recall him ever having achieved before.

Vladimirov is a fine, rich-toned bass of the type which the Slavic countries seem to produce with frequent regularity. His powerful voice is always under complete control and used with great musical intelligence. The soprano, Miroshnikova, sings with the widely-spaced pulse typical of most of the eastern European sopranos I have heard with, perhaps, the exception of Vishnevskaya whose voice is as straight as a sword and has the same steely edge. But despite what sounds to western ears a "forced" production Miroshnikova sings expressively with a fine sense of drama. The Moscow Chamber Orchestra plays no less than superbly throughout and the engineering, despite the sometimes too close recording of the vocal parts, is splendid.

No admirer of Shostakovitch can afford to be without this magnificent example of the composer's genius, a word I am using with full acceptance of its meaning. A violently coloured portrait of the composer on the record sleeve reminds one of the German Expressionist school and well matches the frequent vehemence of the symphony's contents. I found the whole a most moving experience.

★ ★ ★

BRUCKNER — Symphony No 4 in E Flat Major (Romantic). London Symphony Orchestra conducted by Istvan Kertesz. World Record Club Stereo S / 4910.

If you are prepared to sacrifice a little of this symphony's majesty in order to get it on one disc I can recommend this recording, especially at its club price. The Jochum performance (DGG) takes three sides with the fourth side featuring five splendid motets by the same composer. Klemperer has recorded the symphony twice— the first was a bit of a mess, the second much more successful. Somehow I find it difficult to associate the usually fiery Kertesz with the music of Bruckner. In his reading of this work one can easily detect the amount of self-control he exercises to maintain the stateliness of the score by his use of strict, unchanging tempos. Not unexpectedly the Scherzo with its flashing fanfares is the best. It is Klemperer's plodding pace in this movement that spoils his performance for me. I have no complaints along those lines here. I found Kertesz' reading of this movement quite irresistible.

The recording seeks to employ a little too wide a dynamic range so that there are times when the solo horn (Barry Tuckwell?) is often scarcely audible though this does not prevent his faint opening phrase from having a quite magical woodland effect. Otherwise the engineering is efficient enough for most tastes but will not measure up to the standards demanded nowadays by the hypercritical. There is a great variation between this single disc at a club price and the DGG recording on two full price discs although, as I mentioned above, there you have the motets as a fourth side bonus. I think this latter consideration makes the extra outlay on the DGG well worth while. But those not prepared to make the additional outlay should be well satisfied with the WRC issue.

★ ★ ★

DVORAK — Symphony No. 2 in B Flat Major. London Symphony Orchestra conducted by Istvan Kertesz. World Record Club Stereo S / 4892.

Kertesz may not be my favourite Bruckner conductor but I know of none better when it comes to the music of Dvorak, and in this reissue of an original Decca recording at a club price he is in top form. The symphony, composed when Dvorak was only 24, is full of youthful fervour. — and a few indiscretions. You already have evidence of his fertile invention and the scoring has impressive originality with Dvorak's characteristically bold treatment of the brass family flashing like beacons through the score. If at times his argument is a little long-winded I, at any rate, did not find it too unbearably rhetorical. Certainly it is never a bore. The London Symphony Orchestra's playing under Kertesz is, as usual, full of fire and vitality.

★ ★ ★

BEETHOVEN — Violin Concerto in D Major. Coriolan Overture. Josef Suk (violin) and the New Philharmonia Orchestra conducted by Sir Adrian Boult. EMI Stereo OASD2667.

It would be difficult to find a better performance — or recording — of Beethoven's often recorded concerto than this one. It has perfect rapport between the soloist and conductor and between the performers and the recording engineers. I am not unmindful of the stiff competition offered by a few, a very few, recorded rivals of which Oistrakh and Grumiaux are the most considerable. But I can think of no other version that combines all the many virtues of this issue by Suk and Boult. You have a nobly spacious first movement with some of the

Peter Clark says: I guarantee that I have . . .

The widest range of electronic Music-makers in Australia!

Nowhere else will you see such a tremendous selection of Tape Decks, Hi-Fi Systems, Cassettes, Tape Recorders, Accessories! Three floors of music! And every purchase entitles you to FREE membership of the world's largest tape club, free installation, Sydney's lowest terms, lowest deposits, TWELVE MONTHS GUARANTEE and prices everywhere a whole lot lower than list prices on ALL BRANDS.

Sydney's 5 Best Tape Recorders

1. Nivico/Leak $392

Truly a wonderful system for the listener of serious music. Top-quality 3-speed, 4-track tape-deck and amplifier giving 30 watts of glorious music power from two "fine furniture" Leak loudspeakers. $40 deposit. Up to 2 years to pay.

2. The "Sony 252" $243

The most inexpensive, high-quality portable tape recorder! Frequency range 30-18,000 Hz., 3-speeds, 4-tracks; all-silicon, solid-state amplifier; retractable pinch-wheel for easy tape threading. Two top-quality loudspeakers. $25 deposit. Up to 2 years to pay.

3. "Sony 330 Stereo"

Reel and cassette music Centre! Never before such a versatile tape recorder. A full Hi-Fi Stereo reel-to-reel tape recorder, powerful distortion-free amplifier, separate control panel, 2 large stereo loudspeakers, and self-contained stereo cassette recorder/player — feel this through the tape amplifier and the sound!! It's unbelievable! Transfer reels to cassette or records to tape or cassette. Play tape-cassettes or records. $43 deposit.

4. Philips N4407 $279

One of the most exciting tape recorders from Europe for many years. Complete mixing, parallel play and multi-play sound, or sound-duo play. Solid-state amplifier, "Servo" brakes, automatic stops at end of tape. $28 deposit. Up to 2 years to pay. 12 months guarantee.

5. Sony 124CS $239

Complete stereo Cassette-corder, 4-track or 2-track mono, recording and playback. Automatic recording level. Sensitive, wide-response stereo microphone. Sony rechargeabie battery pack or 240 volt A/C. Built-in oval speaker plus 2 separate speakers. $24 deposit. Up to 2 years to pay.

Sydney's Five Best Hi-Fi's

1. Junior Executive $185

"Magnetic Sound's" specially made solid-state Stereo Amplifier with scratch filter and separate bass and treble. 20 watts of music with complete purity through matched "AKAI JET-STREAM" Speakers. Deposit $19. Up to 2 years to pay.

2. Philips "MONACO" $259

Completely new! CONTINENTAL AND VERY "CHIC". The amplifier! OH "LA!! LA!!" 20 watts of music power! Press-button controls. Stereo balance for tapes, records. 3-speed, dynamically balanced. Record player with independent suspension. Loudspeakers in acoustic enclosures with frequency response 20 Hz - 20,000 Hz. Deposit $26.

3. "Indi-500" $329

"Pioneer's" 44 watt solid-state integrated amplifier. Built to very high specifications. Matches Pioneer PL12 record player. Magnetic cartridge. Turntable belt driven. Two CS30 loudspeakers, separate base and treble. Deposit $33.

4. Philips "ST. TROPEZ" $460

Tastefully discreet outward design. The SOUND of the RH 590 amplifier is well known in Europe and is coupled with the GA 308 Hi-Fi. Stereo transcription record-player fitted with Philips Super M cartridge! Listening fully enjoyable at low volume. Loudspeakers 15 LITRES: bass and tweeter in each. Deposit $46.

5. Tape Deck Special $149

Nivuo 3-speed, 4-track stereo tape-deck. Handcrafted teak cabinet, dual recording controls, headphone socket, powerful drive motor, solid-state pre-amplifier. Plays and records through any radio. Deposit $15.

Sydney's 5 Best Sony Cassettes

1. "Sony TC60" $69.90

New, compact Cassette-corder with streamlined styling. AC/DC, completely automatic recording control, piano-key operation, remote control of mike, featherette case. Deposit $7. Up to 2 years to pay.

2. "Sony TC95" $126.90

Alarm automatically signals "end-of-tape" while recording. Fitted with unique "review" and cue keys. Built in Sony Electric Condenser. Microphone, 4 way operation. 240 volts or batteries or rechargeable batteries or 12 volt car or boat battery. Deposit $13. Up to 2 years to pay.

3. "Sony TC110A" $123.49

Versatile ready-to-go Cassette-corder with built-in speakers, sensitive microphone, unique tape and alarm to automatically tell of "End-of-the-tape" while recording with a Sony Auto-Remote control microphone. Deposit $12. Up to 2 years to pay. Guaranteed 12 months.

4. "Sony TC120" $159.00

Portable Cassette-corder for people on the move, running, jumping, walking. Wherever you go, perfect recording is certain with the "Sony TC 120" electric condenser microphone, built-in to free you from bother of an external mike. Deposit $16. Up to 2 years to pay.

5. "Sony CF200" $149.00

Combination Cassette-corder/FM-AM radio system. A winning audio team! Automatic recording with Sony-O-Matic, battery and power operation. Recording time 2 hours. Deposit $15. Up to 2 years to pay. Guaranteed 12 months.

We can always do a little better than the advertised price on SONY.

Magnetic Sound INDUSTRIES

City at 387 George St., one door from Kodak, Tel.: 29-3371

Parramatta, next to O.P.S.M. 20 Macquarie St., Tel.: 635-0830

MS3227

sweetest interludes imaginable but not a trace of sentimentality. It may sound a trifle on the slow side to some but to me everything is so perfectly proportioned that its pace enhances its majesty. And to add to my enjoyment — and I hope yours, too — there is an unfamiliar but excellent cadenza by Vasa Prihoda.

The slow movement, too, is unhurried but held together by Suk's fluid, immaculate melodic line which always receives exemplary support from Boult. The final Rondo skips along like a happy girl. And if all these goodies were not sufficient recommendation to possess this disc, there is a bonus in the form of a grand performance of the Coriolan Overture by Boult and the New Philharmonia. An outstanding production in every way.

★ ★ ★

HOLST — Double Concerto for Two Violins and Orchestra. Capriccio. Ballet Music from The Golden Goose. Two Songs Without Words. Emanuel Hurwitz and Kenneth Sillito (violins) and the English Chamber Orchestra conducted by Imogen Holst. World Record Club Stereo S / 4993.

HOLST — Lyric Movement. Brook Green Suite. Nocturne. A Fugal Concerto. St. Paul's Suite. The English Chamber Orchestra conducted by Imogen Holst. World Record Club Stereo S / 4373.

The Double Concerto sounds most attractive. It is a work of mixed styles, sometimes adventurously polyphonic, sometimes sweetly harmonised, but always very English, for despite his foreign sounding name Holst was English-born and bred. The Finale has echos of Petrouchka though it always remains unquestionably Holstian. Its ostinato theme repeated throughout the movement never becomes monotonous, such is the ingenuity of the surrounding structure and the beautifully clear scoring. Lightweight, perhaps, but of considerable charm.

The Capriccio is based on a "folk tune" composed by Holst. The scoring and harmony are spare at first with the unusual but colourful addition of a merimbula. Later in a syncopated march tune for brass it grows at once more complex and more spirited though never congested. Here the general atmosphere is American rather than English, not surprisingly since the work was commissioned for performance in the United States.

The original score of the Golden Goose was intended for performance as a ballet and included a part for chorus; however, with the composer's approval this was omitted from the concert version. The story of the ballet was an adaptation of the well-known tale by Grimm about a Princess who couldn't laugh. It is true dance music and the action is not very much missed, and any that might be is easily replaced by the imagination. It was written in 1926 for Holst's pupils at St. Paul's School for Girls, and one might be excused for thinking that it was a mighty difficult piece for any school orchestra to play. Played here by the English Chamber Orchestra, as fine a body of mature musicians as you'd find anywhere in the world, who respond generously to Miss Holst's skilled direction, it makes an enchanting little suite.

The two Songs Without Words include a Country Song with a rustic English atmosphere calling up visions of merry dancing around a maypole, and a Marching Song, a gay, virile piece that would lighten the burden of even the longest route march. A most attractive production in every way.

Two of the pieces on the second Holst disc, played by the same admirable orchestra again under Miss Holst's direction, were also written for the St. Paul's Girls School Orchestra — the St. Paul's and Brook Green Suites. The first is probably Holst's best known work for small orchestra and both suites are similar in style — simple, attractive and unaffected. The Nocturne is an arrangement by the composer himself of a movement from his Moorside Suite for Brass Band and transfers effectively to strings. The Lyric Movement, the solo part for viola beautifully played by Cecil Aronowitz, was a late composition of such moving intensity that it is a pity it is not heard more often. It is the outstanding composition on this disc. The Fugal Concerto is best described by its name, and presages the neo-classical style Stravinsky was later to develop during the 1920s.

★ ★ ★

SIBELIUS — Violin Concerto in D Minor. TCHAIKOVSKY — Serenade Melancholique. Scherzo from Souvenir d'un Lieu Cher. Riggiero Ricci (violin) and the London Symphony Orchestra conducted by Oivin Fjeldstad. Decca Ace of Diamonds Stereo SDD276.

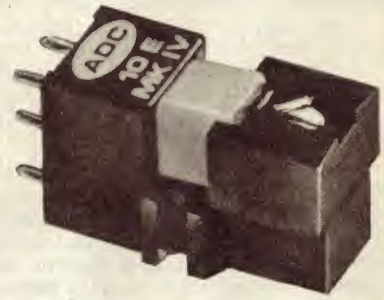
Ruggiero Ricci is well known to Australian concert audiences, having made several Australian tours for the Australian Broadcasting Commission. His performances have always been notable for his effortless technique and unaffected style. It may be of interest to readers to know that this record, when it was originally issued in 1959, was the first stereo version of the Sibelius Violin Concerto.

The sound stands up well to the test of age though, of course, it falls short in some ways of present day standards. It was perhaps the recording engineer and not the soloist who was responsible for occasional thinness of tone in the slow movement though in every other way, Ricci is quite at home in this romantic climate.

Elsewhere Ricci except for some manifest effort during a difficult passage— a rare phenomenon this in a Ricci performance — shows a rewarding mastery of the score. Again perhaps because of the engineering, the orchestra and soloist are not always in satisfactory balance and the solo line is occasionally lost under the weight of the accompaniment. But all things considered this is a performance well worth having if you're not prepared to pay the full price for the perhaps smaller scale but infinitely more refined and beguiling recent recording by the young Kyung-Wha Chung which not only couples the Tchaikovsky Violin Concerto but has the benefit of a truly magnificent recording. I am afraid that the Tchaikovsky trifle used as a fill on the Ricci disc is not nearly of the same weight. The London Symphony Orchestra under Fjelstad give an excellent account of themselves throughout.

IF IT'S BETTER SOUND IT'S....

AND NOW.....
.....THE 10E MK. IV



The latest version of the famous ADC.10E is better than ever, for it incorporates many of the refinements found in the acclaimed ADC.25 and 26. It takes full advantage of ADC's unique induced magnet system, where the heavy moving magnet found in most other high fidelity cartridges is replaced by a hollow tube **weighing at least 60 p.c. less.**

This arrangement also allows the generating system to be placed close to the stylus tip, thus virtually eliminating losses and resonances introduced by a long cantilever.

Coupled with the economies inherent in Audio Dynamics' latest manufacturing techniques, these features make the new 10E Mk. IV probably the finest value in high performance cartridges available today.

SPECIFICATIONS:—

Type	Induced Magnet	Channel Separation	30dB from 50Hz to 12KHz
Sensitivity	4mv at 5.5cms / sec recorded velocity	Compliance	35 units
Tracking Force	0.7 grams	Vertical Tracking Angle	15 degrees
Frequency Response	10Hz to 20Hz plus or minus 2dB	Recommended Load Impedance	47K ohms

THE FULL RANGE OF ADC CARTRIDGES NOW COMPRISES:—

The ADC.220X, Compliance 20 Units
GREAT SOUND IN AN ECONOMY PACKAGE
Conical Stylus — Suggested price $24.00

The ADC.220XE, Compliance 20 Units
GREAT STEREO STARTS HERE
Elliptical Stylus — " $29.00

The ADC.990XE, Compliance 25 Units
HIGH QUALITY ELLIPTICAL STYLUS AT REASONABLE COST — " $35.00

The ADC.660XE, Compliance 30 Units
HIGH POLISH ELLIPTICAL STYLUS — " $45.00

The ADC.550XE,, Compliance 35 Units
HAND CRAFTED QUALITY
Elliptical Stylus — Suggested price $49.00

The ADC.10E Mk.IV, Compliance 35 Units
PREFERRED BY PROFESSIONALS
Elliptical Stylus — " $72.00

The ADC.27, Compliance 40 Units
GRAIN ORIENTED ELLIPTICAL STYLUS — " $81.00

The ADC.26, Compliance 50 Units
THE CRITICS' CHOICE!!
GRAIN ORIENTED ELLIPTICAL STYLUS — " $96.00

The ADC.25, Compliance 50 Units
A "STATE OF THE ART" CARTRIDGE
3 GRAIN ORIENTED STYLI — Suggested price $128.00

Exclusive Interstate Distributors:—

NSW: Electronic Parts Pty. Ltd., 91a York St., Sydney.
SA: The Muses Pty. Ltd., (Sound Spectrum), 33 Regent Arcade, Adelaide.
WA: Arena Distributors (Australasia) Pty. Ltd., 196 Adelaide Tce., Perth.

J. H. REPRODUCERS CO.

293 HUNTINGDALE ROAD, CHADSTONE, VICTORIA 3148
TELEPHONE: 277 3066

Exclusive Australian Agents for — ADC Cartridges and Amplifiers, Kef speakers, J. H. G. H. Unipoise Pickup Arms, Pritchard Arms, TRANSCRIPTOR TURNTABLES and the popular J. H. Synchronous Turntable.

VARIETY FARE

REVIEWS OF OTHER RECORDINGS

Devotional Recordings

SONGS OF PRAISE. John Boulter. Stereo. RCA Camden, OCS-7132.

John Boulter has a very pleasant baritone voice and, in this album, a straightforward presentation which reminded me at times of Bill Newman, or of Pat Boone in his earlier devotional discs. He is supported by the John McCarthy Singers and the Johnny Douglas Orchestra, who provide an appropriate variation in the sound.

The 12 tracks include: Were You There? — Bless This House — O Perfect Love — It Is No Secret — Panis Angelicus — Ave Maria — The Lord's Prayer — The Old Rugged Cross — Steal Away — Agnus Dei — The Story Of The Sparrows — Abide With Me.

This is in no sense a "with it" recording but those who prefer their Gospel and devotional music sung straight and sung well will thoroughly enjoy what John Boulter has to offer. For this listener group — recommended. (W.N.W.).

★ ★ ★

COME ALIVE. The Young World Singers. Stereo. EMI YPRX-1013.

Under the guidance of Sydney businessman Alan Petterson, The Young World Singers is probably the most successful Christian youth group to have emerged in Australia to date. They have performed on stage, for television, for films, for radio and for recordings. They have made very successful appearances interstate and in New Zealand.

On this new album, the singers repeat some of the popular numbers from the Christian musicals and variety programs which they have presented over the years.

Listening to the numbers, one cannot but be aware that they have been conceived and arranged for visual presentation and, fairly obviously, they will be enjoyed most by those who have seen the original performances on stage or per the visual media.

But this is not to say that the program will not be enjoyed by anyone with an ear for the modern youth Gospel sound, with its down-to-earth lyrics and driving rhythm. The titles: Life — Contagious — Happy Side Of Life — Put Your Hand In The Hand — He Is The Way — I Believe — Never Alone — What Would Other People Think? — Relevant — Natural High — Amen — Turn Around — It's A Thing That Grows — Amazing Grace — Try A Little Kindness — It Was Jesus — Happy Sounds — There is More To Life.

To be critical, my first impression was that the sound was rather too "tight" for pure audio as distinct from television — not enough spread, not enough reverberation from the studio. One of the soloists seemed to be suffering from a cold and the hand-clapping was noticeably ragged against otherwise precise accompaniment. But, taken all round, the Young World Singers have acquitted themselves pretty well.

I'm glad I can say this, because I know quite a few of them personally! (W.N.W.).

★ ★ ★

NEW VIBRATIONS. A Quest in Folk Rock. By Tedd Smith, with Ralph Carmichael and The Young People. Soloists John Bahler and Kim Carmichael. Stereo, Light LS-5561-LP (From Sacred Productions Aust., 181 Clarence St, Sydney and other capitals).

Written by Tedd Smith, "New Vibrations" is a Gospel musical on a smaller scale intended to be presented in Churches, halls and school auditoriums. While involving chorus and orchestra, it is essentially dialogue, question and answer between two people, John and Kim.

As a young man, John is seeking the real meaning of life but he doesn't find it. So he just carries on, growing older, repeating the mistakes of his parents — losing touch with his own children, climbing towards the shelf of old age.

The track titles reflect the inexorable march of events, culminating in a belated appreciation of the possible answer to his questions as a youth: "Once Upon A Cross". As indicated by the title, the musical form is rock and, while the performance and the recording are of a high standard, its appeal will be to those who respond to this kind of presentation. It is predominantly by youth for youth. (W.N.W.).

★ ★ ★

HYMNS OF FAITH. Johann Sebastian Bach. Organ Chorales. The last part No. 34-45 from "The Little Organ Book". Organist Horst Christoph Diehl. Stereo, DAVAN LRDS-008. (From Davan Recordings, 21 Ruthven Av, Magill, SA 5072. $5.95).

The much-used title "Hymns of Faith" usually indicates a collection of congregational hymns for the Moody-Sankey era. In fact, these are hymns of a quite different kind, being taken from Bach's "Little Organ Book", which is succinctly described in the jacket notes as "a kind of catechism for organists".

Bach planned to provide 164 organ chorale preludes for the Christian year. Only 45 are known and the last 12 of the group are recorded here. They are quite short items ranging from about 2 to 4 minutes each. In the recording each is divided, for ease of reference, into a choral and a prelude so that, in all, there are 24 tracks.

Horst Christoph Diehl, a talented German musician, made the recording in the Bethlehem Lutheran Church, Adelaide, in August 1970, during a visit as the guest of the Lutheran Church of Australia. The organ is a 3-manual instrument to classical specifications, having 2,193 pipes.

Diehl uses its resources skilfully to produce an album in which the focus is on the music and on the spirit of worship which it is intended to engender. I enjoyed it and I think most will react in the same way who have any feeling at all for the classical organ in a worship situation. (W.N.W.).

★ ★ ★

Instrumental, Vocal and Humour . . .

CLAIRE DE LUNE — The World of the Great Classics, Vol 10. Decca (EMI) stereo SPA 111.

I have had this performance in my collection ever since it was first released here (by RCA) 10 years ago, and I can testify to the enduring appeal it has as a collection of light classics. It happens to have in it my favourite performance of

Reviews in this section are by Neville Williams, Harry Tyrer, Gil Wahlquist, Leo Simpson, Ross Tester, George Hughes.

"Dance of the Blessed Spirits" from Gluck's "Orfeo", with its sublimely beautiful flute solo — the flautist here provides an exquisite performance. Also a particular favourite is a fine rendering of the Bantock arrangement of Bach's "Sleeper's Awake" chorale; another is Elgar's "Dream Children", a delightfully unwordly piece, which I have not found in any other recording.

The remaining items are: Meditation (Massenet) — Chant sans Paroles (Tchaikovsky) — Pavane (Faure) — Claire de Lune (Debussy) — Andante Cantabile (Tchaikovsky) — La Vierge (Massenet).

The mood throughout is one of quiet rest, and many an hour have I spent relaxing tensions under the influence of this soothing music. Recording techniques have come a long way since this disc was made, but the sound is acceptably clean. The stereo is of the reprocessed kind, but very well done, so that one is hardly conscious of this. At $2.75, this disc carries a strong recommendation. (H.A.T.).

★ ★ ★

NOCTURNE — Music for Quiet Listening. The New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS stereo SBR 235447.

Here is another very attractive selection of light classics in quiet mood, played by no less a body of fine musicians than the New York Philharmonic. Included here are: Barcarolle (Offenbach) — Children's Prayer from "Hansel and Gretel" (Humperdinck) — Nocturne from "Carmen" (Bizet) — Adagio for String (Barber) — Dawn from "Peer Gynt" (Grieg) — Fantasia on Greensleeves (Vaughan Williams) — Adagietto from "L'Arlesienne" (Bizet) — Pavane Pour un Infante Defunte (Ravel). If this selection appeals to you, you may safely take for granted the quality of the playing and the sound. A special word of appreciation is due to the fine violin solos of David Nadien in the Carmen and Greensleeves tracks. One point — the review record had surfaces faults on side 2, tracks 1 and 3. In case these are present in the stampers, it would be advisable to check before buying (H.A.T.).

★ ★ ★

MAHLER'S GREATEST HITS. Various artists and orchestras. RCA Victor stereo LSC-5013.

BEETHOVEN'S GREATEST HITS. Various artists and orchestras. RCA Victor stereo LSC-5010.

These disc are among the first in a new series from RCA intended to attract young record buyers with little or no previous interest in the major classics. While the music of Mahler may seem to some people to be a strange choice in this context, there is really no justification for any such reservations. The adagio from the Fifth Symphony, which opens side one has a most appealing melody, reminiscent of the slow movement from the very popular Bruch Violin Concerto. The lilting "Ging Heut' Morgen" from "Songs of a Wayfarer" is the kind of tune one likes to whistle in lighter moments. This is superbly sung here by contralto Maureen Forrester. The remainder of the items are movements from the symphonies, mainly those with choral and vocal parts.

The contents of the Beethoven disc are entirely predictable: the first movement of the 5th Symphony — the Adagio (first movement) of the "Moonlight" sonata — the Shepherd's Song of Thanksgiving After the Storm, from the last movement of the "Pastoral" symphony — and (need I say) the Ode to Joy from the ninth symphony; in this performance, the soloists are no more than competent, the orchestra is sound, but the choral work of the Chora Pro Musica and the New England Conservatory Chorus is superb, and it is evident that they know this score thoroughly. Horowitz plays the "Moonlight" movement — much too fast, in my opinion, and without enough pedal, so that the smooth flow so necessary for a successful performance of this piece is missing. Fritz Reiner conducts the Chicago Symphony in the excerpts from the fifth and sixth symphonies — both satisfying performances. Sound — good throughout; stereo spread — normal. (H.A.T.).

★ ★ ★

MUSIC FOR DREAMING. The Berlin Philharmonic Orchestra, conducted by Herbert von Karajan. DGG Privilege Series (Phonogram Recordings Pty Ltd) stereo 2538 101.

This has been a splendid month for light classics, and although some superlatives has already been used up on discs reviewed above, I had to reserve some for this very fine disc. The major attraction for me was the moving playing of Sibelius' sadly beautiful tone poem "The Swan of Tuonela", as fine a performance of this miniature masterpiece as I have ever heard. Running a close second is Debussy's "Prelude a L'Apres-midi d'un Faun", also a very fine performance. At the other extreme is Massenet's Meditation from "Thais", a trite piece which I find barely tolerable. In between, there are the following: Air (on the G string) from Suite No 3 in D (Bach) — Rondeau from Suite No 2 in B minor (Bach) — Romance from "Eine Kleine Nachtmusik" (Mozart) — Ballade from "Coppelia" (Delibes) — Prelude and Nocturne from "Les Sylphides" (Chopin).

This very fine disc is available at the DGG "Privilege Series" price of $3.98, and at this price it must be regarded as a bargain, particularly as the recording quality is superb, with good stereo spread. Music for dreaming? — no. This is music for listening with close attention, if you want to extract the maximum of enjoyment. (H.A.T.).

★ ★ ★

THE WORLD OF POPULAR SERENADES. Jurgen Hermann's Dancing Strings. Decca (EMI) stereo SPA 131.

I think a suitable description of the music presented here would be Palm Court brought up to date. The music is all of the type we associate with Palm Court performances, but is played in modern rhythmic style — very well played too, and quite tastefully done. The modern treatment is not over-emphasised, and there is a minimum of swing. There are a generous 14 tracks in all, including the following; Japanese Lantern Dance — Destiny — Neapolitan Serenade — Heyken's Serenade — Toselli's Serenade — Melody in F

(Rubinstein) — Narcissus. The recording appears to be a very late one, with excellent sound and compatible stereo. (H.A.T.).

★ ★ ★

EVERYTHING YOU ALWAYS WANTED TO HEAR ON THE MOOG. Produced by Andrew Kazdin and Thomas Z. Shepard. CBS stereo SBR 235452.

Side 2 is devoted to a complete rendering of Ravel's "Bolero", which must have been a monumental task, considering that the Moog synthesiser can provide only one note at a time. Side 1 also has pseudo Spanish music, with Chabrier's "Espana", Lecuono's "Malaguena", the Prelude to Act 1, Habanera and Toreador's Song from Bizet's Carmen. The tracks have been skilfully built up, with more or less faithful imitations of the original instruments, plus the usual assortment of strange sounds found in every Moog performance, and the sound has the usual excellence of synthesised performance, where presumably acousto-electrical transducers are unnecessary.

I imagine the main interest will be for those who are dedicated collectors of synthesiser recordings, but those who have not acquired one for occasional novelty demonstrations may find this one suitable. (H.A.T.).

★ ★ ★

SONGS OF THE BRITISH ISLES. Kenneth McKellar with Orchestra. World Record Club stereo S/4918.

Kenneth McKellar is in his element when singing the kind of lyrical traditional songs included here: Ye Banks And Braes — David Of The White Rock — Cockles And Mussels — Villikens And His Dinah — Island Moon — Sweet Lass Of Richmond Hill — Ellan Vannin — Dance To Your Daddy — Waly, Waly — Bonny Labouring Boy — Twa Corbies — Greensleeves — The Rising Of The Lark — The Ball of Kirriemuir — The Last Rose Of Summer. This type of material lends itself admirably to McKellar's lyrical tenor, and if you have any liking for British folk songs it will be worth your while to investigate what this disc offers. Competent support is provided by a small orchestra under Bob Sharples. Originally from the Decca catalogue, the disc is entirely satisfactory technically. (H.A.T.).

★ ★ ★

SIMON AND GARFUNKEL. The Laurie Lewis Orchestra plays the hits of Simon and Garfunkel. Philips stereo 6357 005.

The orchestra is a local group featuring musicians who will be well-known to many. On trumpets we have Eric Thomsen and Bob Barnard; on guitar, George Golla and Peter Martin; Ken Herron on trombone; Wayne Ford on bass guitar; Warren Daly on drums; and finally on percussion, Ian Bloxsom and John Sangster.

With a line-up of musicians like these one can expect a really polished performance and this is what you get. Being a relatively small group, the Laurie Lewis Orchestra does not make the tunes sound ponderous as do many other larger orchestras — the original character of the tunes remains much the same as Simon and Garfunkel play them.

The 13 titles include all the best known S & G tunes: Mrs. Robinson, Sounds of Silence,

Bridge Over Troubled Waters, and so on, plus some lesser known songs. The quality of the recording is very good, equal to the best from overseas. (L.D.S.).

★ ★ ★

WIGWAM — SOUNDS ORCHESTRAL. Astor 4D Series stereo SPLP 1355.

Sounds Orchestral can be described as a jazz trio with orchestral backing. Their style is orthodox, workmanlike but not outstanding. It is a good record for background listening. Astor describe their 4D Series as featuring the most modern recording techniques. If so, it must need a little sorting out. While recording was clean throughout, the stereo spread was almost non-existent on some tracks and displaced to one side on others.

The 12 tracks are: Family Of Man — Something — Close To You — He Ain't Heavy — Smoke Ritual — Coloured Rain — Wichita Lineman — Classical Gas — By The Time I Get To Phoenix — Shackled — Sleepy Shores. (L.D.S.).

★ ★ ★

THE IMPOSSIBLE DREAM. A Musical Souvenir of the Liberace Show. Stereo, 2-record set, Interfusion (Festival) SITFL-177/8.

This special 2-record set ($7.95) is obviously aimed at the many fans of a pianist-showman who, from a classical background, climbed to a pre-eminent position as a popular entertainer. The double-fold jacket carries biographical notes plus portrait shots posed in the usual Liberace finery.

The music itself is also the usual Liberace material, sentimental, dramatised, ornamented, yet skilfully played, against an orchestral background. There is a brief organ interlude and a few snatches of Liberace monologue.

The line-up of titles includes: Impossible Dream — How Insensitive — Man And A Woman — Moon River — Liszt Concerto — French Medley — "Third Man" Theme — September Song — Laura — I'll Be Seeing You — Exodus — Chopsticks — Tiger Rag — Lover — 14th Hungarian Rhapsody — Tico Tico — Yesterday — America The Beautiful.

Technically, the quality is good and, leaving aside the controversial figure of Liberace, it adds up to a varied and well presented popular piano/orchestra program. (W.N.W.).

★ ★ ★

THE BEST OF LIBERACE. Two record set. MCA (Astor) stereo MAP/S 4230.

Just about everything which has been said above can be duplicated here — even down to the two-disc packaging and the $7.95 price tag. In fact, the only significant difference would be the titles, and even here there is duplication (Moon River — September Song — Third Man — I'll Be Seeing You). Other tracks include: Mack the Knife — Over the Rainbow — Near You — Intermezzo — Greensleeves — Misty — As Time Goes By — Charade — Never On Sunday — Love Letters — Tammy — More — Bewitched — Fascination — Gigi. There are 24 tracks in all, and the discs are technically satisfactory. (H.A.T.).

Light classics on Philips cassettes

Philips have already issued a number of cassettes in this "Classical Masterpieces" series. This new addition of four cassettes, two of them in the longer playing "2LP" series, will put the collector well on the way to a comprehensive library of some of the best known light classics. The music is all typical Palm Court style. The performances range from excellent to merely competent, and the bulk of the performances would appear to be extracted from previously issued LP discs which have presumably gone from the catalogues. This is quite legitimate, since cassette player owners are mostly starting off from scratch in compiling their collections, and there are a great may fine performances in the archives of the record companies which are no longer available on disc.

Here are the contents of each cassette, with brief comments:

7306 003 — Nine Classical Masterpieces. Liebestraum (Liszt) — Song of India (Rimsky-Korsakoff) — None But the Lonely Heart (Tchaikovsky) — Humoresque (Dvorak) — Light Cavalry Overture (Suppe) — La Danza (Rossini) — Poet and Peasant (Suppe) — Waltz in A Flat (Brahms). The pieces originally written for piano are all presented in orchestral arrangements. "Song of India" is sung in Russian by Ruggero Orofino, whose tenor voice has a pleasing quality. The "Lonely Heart" song is presented by soprano Elisabeth Ebert in German — another pleasing performance.

7306 001 — Ten Classical Masterpieces. Grande Valse Brillante (Chopin) — Claire de Lune (Debussy) — Liebeslied, Liebesfreud, Schon Rosmarin, Caprice Viennoise (Kreisler) — Sabre Dance (Khatachurian) — Danse Macabre (Saint-Saens) — Ritual Fire Dance (Falla) — Skaters' Waltz (Waldteufel). Here again, the piano pieces are arranged for orchestra. The four Kreisler pieces are given a lame account by the violin soloist, Egon Morbitzer, but otherwise the performances are all entirely satisfactory; the "Danse Macabre" (Detroit Symphony, conductor Paul Paray) and the "Skaters' Waltz" (Vienna Symphony, conductor Wilhelm Loibner) being particularly enjoyable.

7505 001 — Twelve Classical Masterpieces. Overture "Die Fledermaus" (Strauss) — Tales from Vienna Woods (Strauss) — "Abu Hassan" Overture (Weber) — "Sicilian Vespers" Overture (Verdi) — Cavatine (Raff) — Dance of the Comedians (Smetana) — Emperor Waltz (Strauss) — "William Tell" Overture (Rossini) — Entracte and Ballet Music No 2, from "Rosamunde" (Schubert) — Blue Danube Waltz (Strauss) — Hungarian Dance No 6 (Brahms). This long program is made possible by the "2LP" concept, which cost more than the standard cassettes, and give about 50pc more playing time.

The Strauss waltzes are presented in shortened form, without the preludes and minus some of the repeats, but otherwise they are splendidly played by the Vienna Philharmonic Orchestra under various conductors. In fact, I should say that the performances throughout this cassettte are hard to fault, and of the four reviewed here, I found this one the most enjoyable.

7506 006 — Ten Classical Masterpieces (2LP). Adagio (Albinoni) — Invitation to the Dance (Weber) — "The Merry Wives of Windsor" Overture (Nicolai) — Hungarian Dance No 5 (Brahms) — Jota Aragonese (Glinka) — "The Force of Destiny" Overture (Verdi) — Preludes to Acts 1 and 3, from "La Traviata" (Verdi) — Overture to "Nabucco" (Verdi) — Ballet Suite "Le Prophete" (Meyerbeer). Fine playing throughout makes this also a very enjoyable cassette. The Albinoni Adagio is particularly good, the flute solo being contributed by that outstanding master Jean Pierre Rampal. Also worthy of mention are the fine performances of the Weber and Nicolai items by the London Symphony Orchestra under Charles Mackerras. (H.A.T.)

SPAIN'S CHARM. Carmeluchi Velasquez and his Orchestra. Hispavox (Festival) stereo SHVL-934,143.

The contents are entirely of the type of superficially attractive flamenco the Spanish entertainers provide for tourists, with a continual clacking of castanets, plenty of clapping and foot stamping and numerous "Oles" interjected. This type of material certainly does not reflect the special charm which Spain and its music exercise for me but in small doses it is pleasant enough. The main drawback as far as I am concerned is the lack of variety. One track is very like another, played at an unflagging pace which soon becomes monotonous.

The titles include such well-known numbers as Espana Cani and Tanguillo de Cadiz, but in general the titles are unlikely to be known outside Spain, and I have not listed them on this occasion. The sound quality is satisfactory, but plainly the Hispavox company, in Spain, has not advanced its recording techniques to the level of the big international companies. I think Festival are being over-optimistic in offering this disc at $5.95. (H.A.T.).

★ ★ ★

WITH GRATEFUL ADMIRATION. Wilbur Kentwell at the console of the 3-manual Conn Theatre De-Luxe organ. Stereo, RCA SL-101, 957.

Wilbur Kentwell claims the distinction of having been the first solo artist in Australia to record an LP microgroove album. Played, as I remember it, on a Hammond organ, it featured the music of Richard Rogers. It was followed shortly after by a piano / organ duet recording with the music of Rogers and Hart.

Wilbur Kentwell sounded very much "at home" in those early performances, as he does on this latest release performed on the big Conn electronic, complete with "pipe" loudspeakers. The recording was made in Sydney, at the conclusion of a world tour during which he met and talked with Richard Rogers in New York.

As single numbers and in medleys, the 12 tracks contain far too many titles to list individually but, from the prolific pen of

The compact convenience of Sony's stylish cassette tape decks is drawing more supporters every day

all hands on decks

Sony's TC-122 is the lowest priced stereo cassette deck yet it includes many advanced features like 4-track stereo and 2-track mono recording and playback, Sony-O-Matic — completely automatic recording volume control, solid state amplifier for low distortion, stereo level meter, all-silicon transistor circuitry, headphone jack and sleek design. About $102.00.

Sony's TC-127 introduces a new era of magnificent hi-fi tape cassette stereo sound at a modest price. Features include 4-track stereo and 2-track mono recording and playback, limiter circuit (on-off) to control input level for distortion free recording. Sliding-type recording volume controls for each channel with dual VU meters, tape sentinel lamp to indicate tape is running, 3-digit tape counter, headphone jack, attractive woodgrain cabinet. About $142.00.

Sony's TC-160 is an exceptionally sophisticated cassette stereo tape deck for unrivalled recording and playback. Features closed loop dual capstan drive system, first of its kind ever used in a stereo tape deck for perfect tape tension and to cut down wow and flutter to unusually low level. First hard and durable high performance heads adopted in a cassette deck. Limiter circuit to control input. Optimum manual control with separate right and left meters, sliding type volume controls. Tape selector for change from conventional tape to high performance. Easy loading. Low noise, low distortion solid state amplifier. De Luxe styling. About $268.

Distributed by
JACOBY KEMPTHORNE
SYDNEY: 26 2651, MELBOURNE: 329 6866, ADELAIDE: 53 6117, BRISBANE: 21 0586, PERTH: 26 5725, LAUNCESTON: 25 322, Agents: CANBERRA: 47 9010, NEWCASTLE: 61 4991, PORT KEMBLA: 84 8022.

SONY

TO: Jacoby Kempthorne, 469-475 Kent Street, Sydney. N.S.W. 2000
Please send me, without obligation or cost, information on the Sony Models TC-122, TC-127 and TC-160.

NAME.....

ADDRESS.....

.....POST CODE.....

Richard Rogers, it goes almost without saying that the numbers are tuneful and well known.

In style, Wilbur Kentwell reverts to the full traditional theatre treatment which many will find more pleasing than the "pop" sound which has been evident in some of his other recordings. And, of course, in the Conn Theatre De-Luxe, he has an organ which is designed to give the full theatre sound.

The sound quality is excellent. Well worth a hearing. (W.N.W.).

★ ★ ★

BEYOND THE REEF. Buddy Merrill. Crescendo (Festival) SGNPL-934115.

When the Lawrence Welk TV Show cast visited Hawaii, Buddy Merrill, a guitar playing member of the group, was inspired by the breath-taking beauty of the island paradise to record this selection of old and new Hawaiian favourites, arranged for Hawaiian guitars and orchestra, complete with sounds of surf and seagulls. The care taken to provide interesting arrangements is evident throughout, particularly in "Pagan Love Song". This has a "plunky" bass in the Kaempfert style, adding a touch of Latin American, or even mild rock, to the Hawaiian rhythm. "Hawaiian War Chant" is fast and rousing, with interesting major / minor modulations, and ending with a gradual fade. The remaining titles include: Sea Breeze — I'll Remember You — Moon of Manakoora — Hawaiian Wedding Song — Alohe Oe. (G.F.H.).

★ ★ ★

THE LAST TIME I SAW HER. Glen Campbell. Capitol Stereo SW 22733.

Glen Campbell reveals a degree of versatility on this disc that I did not think he possessed. For example, songs such as "Help Me Make It Through The Night" and theme from "Love Story" he handles very well. And Roy Orbison hits like "Its Only Make Believe" and "Dream Baby" are more polished than they were originally. Glen is well backed up by a fine instrumental group. Recording quality is equal to best and surface noise on my pressing was non-existent.

The 14 tracks also include: Rose Garden — She Understands Me — He Ain't Heavy, He's My Brother — Honey Come Back — I Wanna Live — Today Is Mine — Here We Go Again. Glen Campbell fans should not miss this album. (L.D.S.)

★ ★ ★

SOMETHING SPECIAL Jim Reeves. RCA Victor Stereo LSP-4528.

Although he died about ten years ago, records of Jim Reeves are still very popular as radio disc jockeys can probably testify. Jim Reeves has a singing style somewhere between crooning and Country and Western. The selection of tracks on this disc struck me as being peculiarly melancholy — some would even say maudlin. But older people, who appreciate Bing Crosby, for example, reacted very favourably.

A very good job of remastering has been done on this disc. The recording quality is good and surface noise on the Dynaflex pressing is negligible. Stereo spread is wide, with Jim Reeves right in the centre between the two loudspeakers. The 14 tracks include Guilty — A Letter To My Heart — I'm Gettin' Better — Wild Rose — The Blizzard — Anna Marie — I Won't Forget You — I'm Gonna Change Everything — We Thank Thee. (L.D.S.)

★ ★ ★

THE WORLD OF ANTON KARAS & "HARRY LIME". Decca stereo SPA 118.

Sure to become a collector's item, this disc will be eagerly sought after by those who have fond memories of the film "The Third Man". This reviewer thoroughly enjoyed the disc and it is sure to set anyone reminiscing — it has a curiously evocative quality.

Recording quality of some of the tracks is not good and my sample pressing had some surface noise but this should not worry most buyers.

Harry Lime Theme — Visions Of Vienna — Danube Dreams — The Cafe Mozart Waltz — Anton Karas second theme —

RCA two disc set of opera "plums"

OPERA'S GREATEST HITS. Various artists and orchestra. RCA Red Seal stereo, two record set in folding sleeve VCS 7074.

For lovers of opera "plums" this two disc set for $8.40 offers 23 tracks by leading performers, and as the title implies, some of the most popular arias. Thus, we have Montserrat Caballe, Shirley Verret, Anna Moffo, Leontyne Price, Mirella Freni, Placido Domingo, Carlo Bergonzi, Robert Merrill and John Vickers among the soloists; Leinsdorf, von Karajan, Mehta, Serafin, Solti and Pretre conducting such orchestras as the New Philharmonia, London Symphony, Vienna Philharmonic, Royal Philharmonic, and the Metropolitan Opera; and choruses such as the Ambrosian and Vienna State Opera Chorus.

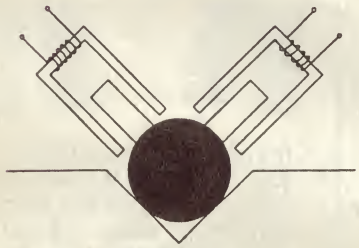
This imposing list virtually guarantees in advance a very high standard of performance, and if your decision is based on "the singer, not the song", the foregoing should be all the recommendation you need.

If the titles play a major part in your reckoning, take my word for it that the titles included in the 22 tracks include some of the most popular from the opera repertoire, although the selection is heavily slanted to the realms of Italian opera. They include the Anvil Chorus from Verdi's "Il Trovatore" — One Fine Day, "Madame Butterfly" (Puccini) — Evening Star, "Tannhauser" (Wagner) — La Donna e Mobile and Quartet, "Rigoletto" (Verdi) — Il Mio Tesoro, "Don Giovanni" (Mozart) — Softly Awakes My Heart, "Samson and Delilah" (Saint-Saens) — Largo al Factotum, "Barber of Seville" (Rossini). Also included are arias and ensembles from Carmen (Bizet) — Aida and La Traviata (Verdi) — Carmen (Bizet) — Lucia de Lammermoor (Donizetti) — Norma (Bellini) and others.

I believe that most, if not all, of these tracks are from currently available opera sets in the RCA catalogue, and consequently the sound is of modern quality. (H.A.T.)

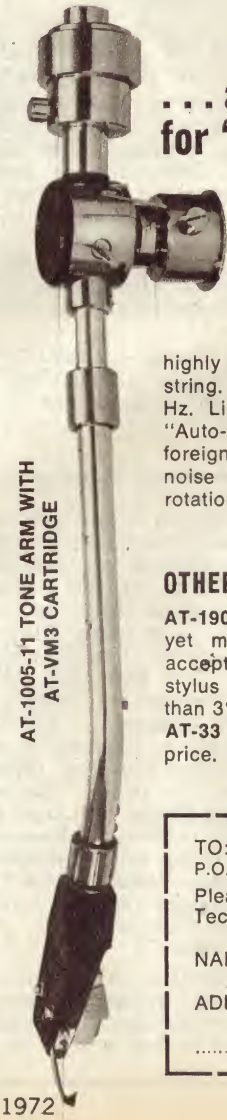
AUDIO-TECHNICA *swear to reproduce*

the groove... the whole groove ...and nothing but the groove



Here's how it's done—

The AUDIO-TECHNICA original VM stereo cartridge is expressly designed to comply with the 45/45 modulation of a stereo disc's grooves—utilising a V-shaped transducing magnet in a mechanical vibration system and a separate generating structure for each channel. This results in perfect true-to-life "natural sound." Extreme clarity, precise reproduction of transients, complete lack of colouration, vivid presence are immediately apparent to the listener. Whether you are amateur, musician or technician, you will appreciate the truly rewarding experience AUDIO-TECHNICA pick-ups offer you. They are the closest approach to the original "natural sound."



AT-1005-11 TONE ARM WITH AT-VM3 CARTRIDGE

. . . and here's a perfect combination for "natural sound"

AT-1005-11 TONE ARM. Universal type with plug-in head shell. Direct reading stylus pressure control system. Overall length: 320 mm. Tracking error: less than 1° 30″. List Price: $38.25. **AT-VM3 CARTRIDGE.** VM (V-magnet) type stereo cartridge. Light-weight moving element supported by wired damper mechanism. Designed to minimise tracing distortion. A newly developed highly polymerised crystal compound is used for the suspension string. Easy stylus replacement. Frequency response 20-25,000 Hz. List Price: $18.20. **AT-6001 AUTO. DISC CLEANER.** The "Auto-Cleanica" . . . a perfect cleaner to take up and absorb foreign matter from a record being played. Reduces surface noise and wear of record and stylus. Automatically trails with rotation of record. List Price: $5.95.

OTHER AUDIO-TECHNICA PRODUCTS INCLUDE—

AT-1901 TONE ARM. A low cost arm with simplified mechanism yet maintaining precision bearing accuracy. Universal type, accepts standard plug-in heads. Direct reading calibration of stylus pressure. Overall length: 275 mm. Tracking error: less than 3° 30″. List Price: $22.95.

AT-33 CARTRIDGE. A VM type stereo cartridge at an economical price. Frequency response: 20-22,000 Hz. List Price: $16.35.

AUDIO-TECHNICA

Distributed by:

JACOBY MITCHELL

Agents in All States

TO: **Jacoby, Mitchell & Co. Pty. Limited**
P.O. Box 2009, North Parramatta, N.S.W. 2151

Please send full information on the range of Audio-Technica products.

NAME.....

ADDRESS.....

.....POSTCODE.....

JM/74-71AEA172

Wien, Weib, Wein — Lili Marlene — Drink Brothers Drink — In Grinzing — Im Prater Bluh'n Wieder die Baume — Zither Man — Vienna, City Of My Dreams. (L.D.S.)

★ ★ ★

HIGH POWER HAMMOND. Harry Stoneham. Stereo, HMV Studio 2 series 259. SOELP-9779.

In the jacket notes Harry Stoneham is introduced as a talented and versatile "back room" musician, who seldom stars but who frequently finds a place in top-line recording groups playing anything from jazz to quasi-classical. Harry Stoneham certainly gives a good account of himself here playing Hammond organ, electric harpsichord and jangle piano. But he doesn't have it on his own, with other musicians supplying trumpet, flugelhorn, guitars, drums and percussion in generous helpings.

What emerges is a spirited combo sound with the organ prominent but certainly not in the solo role that one might assume from the title.

The 11 tracks are all brackets covering about 25 numbers like "Moon River", "Greensleeves", "Sucu Sucu" and "Chihuahua".

The quality and stereo are both excellent. (W.N.W.).

★ ★ ★

THE PHASE 4 WORLD OF SHOW STOPPERS. Various orchestras and artists. Decca stereo SPA 162.

Decca should call this disc a sampler, because that is what it is. Little more can be said about it, except that the quality is excellent throughout and so is the pressing. The London Festival Orchestra conducted by Stanley Black play: Hello Dolly — If I Were A Rich Man — There Is Nothing Like A Dame — There's No Business Like Show Business; Ted Heath and his band: Do-re-mi — The Man I Love; Edmundo Ros and his orchestra: Aquarius; Johnny Keating and his orchestra: The Stripper; Frank Chacksfield and his orchestra: Zorba's Dance; Ronnie Aldrich and his two pianos: The Impossible Dream.

Other tracks are "Stranger in Paradise" sung by Adele Leigh and Kenneth MacKellar with the Mantovani orchestra; and "Mame" by Kenny Baker on trumpet. (L.D.S.).

★ ★ ★

LOVE STORY. Robert Leeman, harmonica, with the Tommy Tycho Quintet. CBS stereo SBP 234008.

After the excellent disc of unaccompanied harmonica solos Robert Leeman made last year for CBS, entitled "Theme from A Summer Place", this new recording proved to be something of a disappointment. Leeman's harmonica sounds thin and querulous and the accompaniments by the Tommy Tycho Quintet are stuffy and do nothing to enhance the harmonica playing. The stodgy strict tempo percussion seems to be cramping Leeman's style, too.

If you enjoyed the previous Leeman disc, ask your dealer to let you hear a track or two — you may find more to enjoy here than I did. The best tracks are "What Now My Love", where a strict tempo bolero type rhythm is an advantage anyway; and "Manha de Carnaval", where the Latin American rhythm allows Leeman more freedom of expression. Some of the other tracks are: Love Story — More — Moon River — This is My Song — Shadow of Your Smile. The quality of this local recording compares favourably with modern overseas recordings. (H.A.T.).

★ ★ ★

TRES GUITARRAS TIENE SABICAS. Sabicas, guitar. Hispavox (Festival) stereo SHVL-932258.

The title of this disc translates into English as "Sabicas has three guitars". So he may well have, and he appears to be playing all three simultaneously on this disc, where by over-dubbing he plays all three parts of some Spanish flamenco and traditional music arranged for a three guitar performance. Sabicas' reputation as a guitarist is already well established from numerous discs he has made, and I question the wisdom of his indulging in the kind of gimmicky practised here. However, he certainly plays very competently, and if flamenco and traditional Spanish music attracts you, you should find this performance pleasant enough listening.

Side 1 starts with the familiar tango "La Cumparsita", but otherwise I feel the items will be unfamiliar to most buyers. One track is entitled "La Virgen de la Macarena", but this is not the usual tune one hears under this title, associated with the bullring. "Melodias del Norte" is apparently a number of folk tunes from north Spain, and "Seis Sevillans" has six Sevillian tunes, including one used by Albeniz is "Sevilla" from his "Suite Espanol". There are nine tracks in all. The performance has been very well recorded, and is much better, in fact, than previous Hispavox recordings I have heard. (H.A.T.).

★ ★ ★

THE AUSTRALIAN. Bob King Crawford. RCA mono L101921.

This presents in dialogue form a series of sketches purporting to show the Australian way of life for the guidance of our overseas friends. Not surprisingly, much of the action takes place in the pub, but there are send ups of the sporting scene and historical events. If you are familiar with Shakespeare and opera, you will appreciate the typical pub bar orator telling how he was "volunteered" into the higher arts by his wife. It is all good clean humour, and the following track titles should give some clues as to what the action is all about: Puss in Boots — Snowy White and the Seven Jockeys — Captain Cook's Landing — Southern Horrorscope — Madame Butterfly (in a bar) — Ned Kelly Interview — Man in the Street — Hamlet Part 1 — Hamlet Part 2 — Hamlet Part 3 — Swan Lake — Eureka Stockade — Sports Roundup — Erb's Three Minute Mile — Woman Driver — The Inventor — Merchant of Venice — Captain Cook's Stoker — The Technition. (G.F.H.)

★ ★ ★

OWYAGOIN' John Vincent. RCA Camden, mono OCM178.

John Vincent is an Adelaide disc jockey, who has had two singles released — both of which are on this album. To quote him, "Neither of these records was intended to be anything else but a fun record, which I think they were successful in being."

The only thing I found funny about them

NEW ALL TRANSISTOR STEREO AMPLIFIERS WITH IN-BUILT AM TUNER
ULTIMATE IN DESIGN — LONG DEPENDABILITY

USING ALL SILICON TRANSISTORS 40 WATTS — RMS

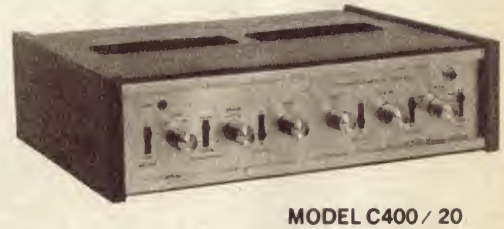
SPECIFICATIONS:
20 watts per channel RMS.
Total output 40 watts RMS.
FREQUENCY RESPONSE:
From 20 to 20,000Hz ± 1dB.
HARMONIC DISTORTION:
Less than 1 per cent of rated output.
HUM AND NOISE:
Aux 70dB, Mag 50dB.
INPUT SENSITIVITY:
Mag 3mV, Aux 200mV.
SPEAKER IMPEDANCE: 8 ohms.
EQUALISED: Mag RIAA.
TONE CONTROLS: Bass, 50Hz ± 12dB; Treble, 10KHz ± 12dB.
LOUDNESS CONTROL: 50Hz 10dB.
SCRATCH FILTER:
(High filter) at 10KHz 9dB.
RUMBLE FILTER:
(Low filter) at 50Hz 5dB.
PROVISION FOR TAPE RECORDER: Record or playback with DIN plug connection.
PROVISION FOR HEADPHONES: With headphone / speaker switch on front panel.
DIMENSIONS: 16½ x 5½ x 11in deep.
TUNER: This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1600 KHz. Calibrated dial available for all states.
THE CIRCUIT incorporates regulated power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.

$134.00
PLUS FREIGHT
(CABINET EXTRA)

MODEL C300 / 20 / T
(with Tuner)

$108.00
PLUS FREIGHT
(CABINET EXTRA)

AMPLIFIER ONLY
Specifications as above but with the added feature of front panel switch which allows selection of two speaker systems.



MODEL C400 / 20

Cabinets for above in teak or walnut with metal trim, $10 extra.

THE NEW MAGNAVOX 8-30 SPEAKER SYSTEM

Complete System (1.6 cubic ft.) in Walnut or Teak Veneer, Oiled Finish. (regret no mail orders for complete system.) — — **$60.00**
Speaker Kit (less cabinets) COMPRISING 1-8 / 30 Speaker, 2-3TC Tweeters, 1-3in. Tube, 1-4 or 2uF Condenser, Innerbond and Speaker Silk Available in 8 or 15 ohms. Postage $1.50 extra. **$29.50.**

NEW 6 WATT STEREO AMPLIFIER WITH A.M. TUNER

$79.50
FREIGHT & PACKING EXTRA
N.S.W. $1.75
Interstate $2.75.
Dimensions 12½" x 3½" x 9" deep

A high quality stereo amplifier incorporating the new Plessey SL403D I.C. audio amplifiers with separate bass and treble controls with inbuilt high gain A.M. tuner giving a coverage of 530 to 1600KHz with calibrated dial available for all States. Timber cabinet available in teak or walnut oiled finish.

SPECIFICATIONS:
DISTORTION:
Less than 1.5 per cent THD at 1KHz, less than 0.5 per cent at 100mW at 1KHz.
SIGNAL TO NOISE RATIO:
-62dB with respect to 3 watts into 8ohms.
FREQUENCY RESPONSE:
Within 2dB from 20Hz to 100KHz.
TONE CONTROLS:
Bass control 15dB boost or cut at 50Hz, treble control 14dB boost or cut at 10KHz.
INPUT SENSITIVITY:
250mV for all imputs, tape, aux. or phono.
SHORT CIRCUIT PROTECTION.

Above amplifier tuner supplies with two Magnavox 8WRMkV speakers, two 3TC tweeters, 2 4mfd. condensers and Garrard SRP22 record player with Sonatone ceramic cartridge.
Details of speaker cabinet with innerbond and speaker silk supplied. **$130.00** ***FREIGHT EXTRA***

NEW ALL-TRANSISTOR AM TUNER WITH PREAMPLIFIER

$49.00

Suitable for use with all valve or transistor HI-FI amplifiers, tape recorders or PA amplifiers

SPECIFICATIONS

Frequency coverage 530 to 1600KHz, bandwith 9KHz. Inbuilt aerial, provision for external aerial. 240V AC operation. Dimensions 10¾ x 6 x 3½ins. Output variable from 50mV to 700mV.

Post and packing $1.50

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, 2045 N.S.W. PHONE 798 7145

was the looks of disbelief on the faces of people who heard them.

The cover notes state that some of Vincent's critics describe the record as "Vin's Multitude of Dins". However, it is not the din which worries me so much as the way the din is presented!

Vincent attempts to sing here a number of songs of his own composing — Australian songs in something like a country and western style. He relies heavily on stretching the "Strine" in his voice to the limit — a thin gimmick of which one very soon tires.

Mr. Vincent should stick to being a disc jockey. He is certainly not a singer. He is terribly flat in more than a few parts, and his voice (of which "owyagoin" is a very apt description) is certainly not easy to listen to. A fun record? I don't think so, not unless you are "funny" yourself. (R.P.T.)

★ ★ ★

JAZZ SPECTRUM — INTRODUCTION TO JAZZ, Ray Price Quartet ATA Records stereo Two LPs SATAL-166.

The records are accompanied by a 12-page book written by a number of people in and out of the Australian jazz scene.

The quartet plays a representative selection of jazz styles. Improvisation lines, counterpoint, blue notes are beautifully displayed in the musical performances.

The intention was to provide a worthwhile and enjoyable jazz performance which could be used for teaching. What an enjoyable lesson! Trumpeter Bob Barnard is featured on the record. He is Australia's most talented hot trumpet player. Paul Simpson plays clarinet and associated reeds. The reeds have reflected the many phases of jazz and Simpson blows hot in all of the styles.

Col Nolan plays good piano and Tony Carlino keeps the group moving at drums. Ray Price leads from banjo and guitar. Jeannie Lewis sings "Easy Rider", "I Wish I Knew" and "Careless Love".

The numbers played by the quartet range from "Yellow Dog Blues" and "The Saints" to "Peanut Vendor". — (G.W.)

★ ★ ★

IN THE BEGINNING. Don Burrows Quartet. Cherry Pie stereo CPS 1009.

If the new Cherry Pie label keeps up this standard of performance and presentation we will run out of superlatives. The first disc was Johnny Sangster's "Australia and all that Jazz" (reviewed in November). This disc has an equally lavish package. Four lithographs of old Sydney are contrasted with illustrations of Sydney today. While you are looking at the pictures, hot jazz soars from the LP.

Like Sangster, Burrows is one of our leading environmental jazzmen. I would rate Burrows as being consistently above Sangster. Burrows is a dedicated exponent of style. "Passing the Bach", which opens the album, makes this point very well. Here is the style of the classical composer most beloved of jazzmen and Burrows develops it as an all-Australian improvisation.

"Whenever" is a bossa nova, a rhythm which is popular with this group. The beat and Burrows' soaring flute suggests the walk of birds, a theme which recurs in Burrows' playing. Homework assignment: Watch a bird in the garden while playing this LP.

Guitarist George Golla and bassist Ed Gaston are superb quartet members, taking a full share of the creative responsibility. Drummers Alan Turnbull and Laurie Bennett appear on different tracks. Their playing is polished and sophisticated.

Warren Mills and Max Harding were engineers on the recording date, with technician Godfrey Gamble. They have achieved a warm sound, providing excellent listening for home and abroad. (G.W.)

★ ★ ★

BEST OF COUNT BASIE AND ORCHESTRA. MCA stereo MAP / S 1788.

I'm repeating the label information that this is stereo because it has been remastered for stereo reproducing equipment. The performances were recorded between 1937 and 1939 and chronicle the achievements of an extraordinary band of great power and attainment. When you hear the sophistication of "Panassie Stomp" and remind yourself that a mere 20 years beforehand jazz was just getting started, you can only wonder at the rate of development of both the musicians of the day and of the audiences who supported them.

Basie had started life as a stride pianist. I suppose that is where most jazz began. To oversimplify things, he split up the elements of a complex jazz piano solo and distributed them around a 13-piece orchestra.

When 13 hearts start to beat as one, and feel as one, a new and most rhythmic form of swing jazz resulted. It's all on this remarkable two-LP album. (G.W.)

★ ★ ★

COMES AUTUMN. Autumn. Warner Brothers stereo 20003.

After coming close to winning the national battle of the sounds in 1970 on a teeny-bopper ticket, Autumn has developed a whole new repertoire of their own in a more mature idiom.

Their LP covers a number of styles from ballad ("Falling") country ("Miracles") and baroque ("Lady Ann") to hard rock ("Get it Down"). All of the songs are originals.

The basic guitar and organ line-up of the group has been augmented by strings and brass arranged by Richard Bowden. Alan Marshall's song "Kill My World" had been developed as an interesting concert piece.

Autumn have a warm, melodic approach, satisfying without surprises. The sound and production by G. Wayne Thomas is first class. (G.W.)

★ ★ ★

HOLD ON IT'S COMING. Country Joe McDonald. Vanguard stereo VSD-79314.

Since leaving the Fish, or rather disbanding them, Joe has become a trans-atlantic minstrel, performing anc recording, as he did for this LP, on both sides of the big ditch.

Like many other performers, he is moving away from the political songs which got him started. There's more self-examination and a reporting of phenomena.

The title song is a mystical piece, having the advantage of a good beat behind it. The accompaniment favours the acoustic guitar and Joe comes through as an exceptional performer of blues. (G.W.)

3 SIMPLE STEPS TO RECORD PLAYING SUCCESS.

1. INVEST IN THE BEST TURNTABLE AVAILABLE. THORENS

Choose from the Model TD-125 or the TD-150 Mk. II. Then you can share the opinions of leading overseas reviewers: *"the best three-speed manual we've ever tested"* — ("High Fidelity"), *"wow and flutter were as low as we've ever measured"* — ("Stereo Review"), *"a favourite contender in the best turntable category"* — ("Audio"), *"it would be hard to imagine a unit that performs better"* — ("Electronics World").

Examine Thorens specifications closely and critically. The new Model TD-125 features: ● Transistor governed 16-pole synchronous motor ● ±2% speed control on all speeds ● Belt drive ● 7½ lb. 12″ turntable ● Wow and flutter ±0.08% ● Rumble —68dB. ● Fine Swiss craftsmanship.

The lower priced Thorens TD-150 Mk. II offers: ● 16-pole synchronous motor ● Belt drive ● 7 lb. 12″ diameter turntable ● Two speeds — 33⅓ and 45 rpm ● Wow and flutter ±0.09% ● Rumble —65 dB.

When you've purchased your Thorens turntable . . .

2. ADD AN ORTOFON M15 STEREO CARTRIDGE.

After many years research, Ortofon have designed a new stereo cartridge which maintains the proud traditions of the Ortofon name. Featuring new principles, the high performance standards which have made Ortofon world famous have been preserved in the new Series M15 and MF15. Over 80% of professional users such as the radio and television stations (and recording studios) specify Ortofon equipment.

BASIC SPECIFICATIONS:

Weight of cartridge: *5 grams.*
Frequency response: *20 Hz. to 10 kHz. ± 1 dB.*
20 Hz. to 20 kHz. ± 2 dB.
Recommended load: *47 k ohms.*
Channel separation at 1 kHz. *Greater than 30 dB.*

Having equipped yourself with a fine player and cartridge . . .

3. KEEP YOUR RECORDS CLEAN WITH WATTS EQUIPMENT.

Airborne dust and dirt are the greatest enemies of your records and cause untold amounts of noisy interference.

We recommend:

THE WATTS "DUST BUG" . . . which cleans the record, removing dust and static charges as the record plays. Surface noise is reduced considerably.

THE WATTS "DISC PREENER" . . . designed expressly for records which have not had previous anti-static treatment. The "Disc Preener" keeps new records like new.

THE WATTS "MANUAL PARASTAT", Model Mk. IIA. . . . is a dual purpose record cleaner designed to maintain new records as new and to restore fidelity to older discs.

Ask for a copy of the Watts Guide to Record Cleanliness when you visit your record store.

**It's easy to follow the Three Steps to Success. Call at your nearest franchised Simon Gray dealer's showroom. He'll be delighted to tell you all about Thorens turntables, Ortofon stereo cartridges and Watts record cleaning equipment!*

SG TOW 3/71

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101*, Telex 31904; **Sydney Office:** 53 Victoria Ave., Chatswood, N.S.W. Tel. 40 4522*; **Canberra Office:** 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 95 6526; **Adelaide Office:** 301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6219. **INTERSTATE REPRESENTATIVES: N.T.:** Pfitzner's Music House, Smith St., Darwin. Tel. 3801; **Q'land:** Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. Tel. 58 1422; **Tas.:** K. W. McCulloch Pty. Ltd., 57 George St., Launceston. Tel. 2 5322; **W.A.:** Athol M. Hill Pty. Ltd., 613-615 Wellington St., Perth. Tel. 21 7861.

Simon Gray Pty. Ltd.,
28 Elizabeth Street,
Melbourne 3000.

Please send me all the facts about: (a) Thorens turntables; (b) Ortofon cartridges; (c) Watts record cleaning equipment . . . and the name of my nearest franchised Simon Gray dealer.

NAME.....

ADDRESS.....

.....**POSTCODE**.....

AUSTRALIAN BROADCAST STATIONS

MEDIUM-WAVE STATIONS

KHz	Call	Location		Watts
530	2KM	Kempsey	d	2K
	3UL	Warragul	d	2K
	4KZ	Innisfail-Tully	d	2K
	6DL	Dalwallinu	n	10K
540	4QL	Longreach	n	10K
	7SD	Scottsdale.	d	2K
550	2CR	Orange	n	50K
560	2ML	Murwillumbah	n	200
	4AM	Atherton	d	2K
	6WA	Wagin	n	50K
	7BU	Burnie		2K
570	2BH	Broken Hill [1] (660)		500
	4JK	Julia Creek [2]	dn	10K
580	3WV	Horsham	n	50K
590	4QR	Brisbane	n	50K
600	4AT	Atherton [3] (720)	n	4K [1]
	4MS	Mossman [2]	n	1K
	6NM	Northam	n	200
	6PH	Port Hedland	n	2K
	7ZL	Hobart	n	10K
610	2FC	Sydney	n	50K
620	3AR	Melbourne	n	50K
630	4QN	Townsville	n	50K
	7QN	Queenstown	n	400
640	5CK	Port Pirie	n	10K
650	2NU	Tamworth	n	10K
	6AL	Albany	n	400
	8DR	Darwin	n	2K
660	2BH	Broken Hill [5] (570)		200
	2BY	Byrock [2]	dn	—
	6GF	Kalgoorlie	n	2K
670	2CO	Albury	n	10K
	6BE	Broome	n	50
	8KN	Katherine	n	50
	9LA	Lae	n	2K
680	2KP	Kempsey	n	10K
	6BS	Busselton	n	4K
	8TC	Tennant Creek	n	50
690	4KQ	Brisbane		2K
	5SY	Streaky Bay	dn	2K
700	2NR	Grafton	n	50K
710	4QW	St George	dn	10K
	7NT	Launceston	dn	10K
720	2TR	Taree (1000)	n	200
	4AT	Atherton [1] (600)	n	4K [1]
	4QA	Mackay [4] (760)	n	2K
	6WF	Perth	n	50K
730	5CL	Adelaide	n	50K
740	2BL	Sydney	n	50K
750	4QS	Toowoomba	n	10K
760	2AN	Armidale	n	50
	4QA	Mackay [1] (720)	n	2K
770	3LO	Melbourne	n	50K
780	2KA	Katoomba		2K
	4TO	Townsville		2K
	6VA	Albany		2K
790	4QG	Brisbane	n	10K
800	4QY	Cairns	n	2K
	5RM	Renmark		2K
810	2BA	Bega	n	10K
	6WN	Perth	n	10K
	9RB	Rabaul	n	2K
820	2GL	Glen Innes	n	10K
830	3GI	Sale	n	10K
	6GN	Geraldton	n	2K
840	4RK	Rockhampton	n	10K
	6ED	Esperance	n	1K
	7QT	Queenstown		500
850	2CY	Canberra	n	10K
	6CA	Carnarvon	n	200
860	4GR	Toowoomba		2K
	6AM	Northam		2K
	7HO	Hobart		2K
	9MD	Madang	n	2K
870	2GB	Sydney		5K
	6DB	Derby	n	2K
880	3YB	Warrnambool	d	2K
	4WK	Warwick		2K [1]
	6PR	Perth		2K
890	5AN	Adelaide	n	50K
900	2LM	Lismore		2K
	6BY	Bridgetown		2K
	7AD	Devonport		2K [1]
	8HA	Alice Springs		2K
	9GR	Goroka	n	2K
910	4QB	Maryborough	dn	10K
	4QO	Eidsvold	n	10K
920	2XL	Cooma		2K [1]
	4VL	Charleville		2K [1]
	6NA	Narrogin		2K
930	3UZ	Melbourne		5K
	4CD	Gladstone	d	2K
940	4AY	Ayr	d	2K
	7ZR	Hobart	dn	10K
950	2UE	Sydney		5K
960	3BO	Bendigo		2K
	6TZ	Bunbury		2K
970	2MW	Murwillumbah [1] (1440)	d	2K
	5DN	Adelaide		2K
980	3HA	Hamilton		2K
	4RO	Rockhampton		2K
	6KG	Kalgoorlie		2K
990	2GZ	Orange		2K
1000	2NB	Broken Hill	dn	2K
	2ST	Nowra [2]	d	2K
	2TR	Taree [1] (720)	dn	2K
	6PM	Perth		2K
1010	4CA	Cairns		2K
	4IP	Ipswich		2K
	6GE	Geraldton		2K
	7EX	Launceston		2K
1020	2KY	Sydney		5K
1030	3DB	Melbourne		5K
1040	2UH	Muswellbrook	dn	1K
	5PI	Crystal Book		2K
1050	2CA	Canberra		2K
1060	3CV	Maryborough	d	2K
	4SB	Kingaroy		2K
1070	2RG	Griffith		2K
	6WB	Katanning		2K
1080	2MO	Gunnedah		2K
	4MI	Mount Isa	n	200
	6IX	Perth		2K
	7HT	Hobart		2K
1090	3LK	Horsham		2K
1100	4LG	Longreach		2K
	6MD	Merredin		2K
	7LA	Launceston		2K
1110	2UW	Sydney		5K
1120	4BC	Brisbane		2K
1130	2AD	Armidale	d	2K
	3CS	Colac	d	2K
	6CI	Collie		2K
1140	2HD	Newcastle		2K
1150	2WG	Wagga		2K
1160	4MB	Maryborough		2K
	5PA	Naracoorte	dn	10K
1170	2CH	Sydney		5K
1180	3KZ	Melbourne		5K
1190	2NZ	Inverell		2K
1200	4GG	Gold Coast	d	2K
	5KA	Adelaide		2K
1210	2GF	Grafton	d	2K
	6KY	Perth		2K
1220	4AK	Oakey		2K
	5EP	Port Lincoln [2]	d	2K
1230	2NC	Newcastle	n	10K
1240	3TR	Sale	d	2K
	8DN	Darwin		2K
1250	2DU	Dubbo		2K
	9PA	Port Moresby	n	2K
1260	3SR	Shepparton		2K
1270	2SM	Sydney		5K
1280	3AW	Melbourne		5K
1290	2TM	Tamworth		2K
1300	4BK	Brisbane		2K
1310	2GO	Gosford	d	2K
	5AD	Adelaide		2K
1320	3BA	Ballarat		2K
	4NA	Nambour	d	2K
1330	3SH	Swan Hill		2K
	4BU	Bundaberg		2K
1340	2LF	Young		2K
1350	3GL	Geelong		2K
	4GY	Gympie		2K
1360	2NX	Bolwarra		2K
1370	2LT	Lithgow		500
	4LM	Mount Isa		2K
	5SE	Mount Gambier [2]		500
1380	2GN	Goulburn		2K
	4MK	Mackay		2K
1390	4BH	Brisbane	d	2K
1400	2PK	Parkes		2K
1410	2KO	Newcastle		5K
1420	3XY	Melbourne		5K
1430	2WL	Wollongong		2K
1440	2MW	Murwillumbah [3] (970)		2K
1450	2MG	Mudgee	d	2K
	5AU	Port Augusta	d	2K
1460	2NM	Muswellbrook		2K
	5MU	Murray Bridge		2K

EXPLANATORY NOTES

d Uses directional aerial.

n National broadcasting service.

[1] Operates at night or during specified periods on half power.

[2] Projected station.

[3] To change to frequency in brackets.

[4] Not yet operating on this frequency. The existing frequency is shown in brackets.

[5] Directional aerial to be installed and power increased to 2KW.

—Details not yet available.

All call signs commence with a number which indicates the state or territory in which the station is located. The numbers are allocated:

2 New South Wales including the Australian Capital Territory
3 Victoria
4 Queensland
5 South Ausralia
6 Western Australia
7 Tasmania
8 Northern Territory
9 Territory of Papua and New Guinea

KHz	Call	Location		Watts
1470	3MA	Mildura		2K
1480	2BE	Bega		2K[1]
	4ZR	Roma		2K[1]
1490	2AY	Albury		2K
1500	2BS	Bathurst	d	2K
	3AK	Melbourne	d	5K
1510	2NA	Newcastle	n	10K
1520	2QN	Deniliquin		2K
	9WK	Wewak*	n	2K
1530	2VM	Moree		2K
	5LN	Port Lincoln	n	200
	8AL	Alice Springs	n	200
1540	2CN	Canberra	n	2K
1550	4QD	Emerald	n	50K
1560	2RE	Taree		2K
1570	2CP	Cooma	n	50
	2LG	Lithgow	n	200
	3WL	Warrnambool	n	200
	4GM	Gympie	n	200
	4HU	Hughenden	n	50
	5LC	Leigh Creek	n	50
1580	2WN	Wollongong	n	2K
	5MG	Mount Gambier	n	200
	5WM	Woomera	n	50
1590	4SO	Southport	n	200
	5MV	Renmark	n	2K
1600	3NE	Wangaratta		2K[1]

SW STATIONS

The Australian Broadcasting Commission has short-wave broadcasting stations located in several states and in the Territory of Papua and New Guinea. These provide a service to distant sparsely populated areas of the commonwealth and territories.

The short-wave service transmits programs obtained as follows: VLI takes NSW regional programs; VLH relays 3AR; VLR relays 3LO; VLM and VLQ take Qld regional programs; VLW takes WA regional programs; VLK and VLT relay 9PA.

Call	Location	Watts
VLH	Melbourne	10K
VLI	Sydney	2K
VLK	Port Moresby	10K
VLM	Brisbane	10K
VLQ	Brisbane	10K
VLR	Melbourne	10K
VLT	Port Moresby	10K
VLW	Perth (two services on two frequencies)	10K and 50K

The frequencies on which these stations transmit are varied as necessary to obtain optimum results.

Radio Australia

Transmitters for the overseas service of Radio Australia are located at:

Shepparton, Vic	4 x 100KW, 3 x 50KW, and 1 x 10KW
Lyndhurst, Vic	2 x 10KW
Darwin, NT	3 x 250KW

These stations are capable of operating on various frequencies and antennas as required to give best reception in the selected areas. In common with all international broadcasting stations, Radio Australia has no assigned frequencies, but is allocated certain frequencies for use during definite periods.

OVERSEAS STATIONS

"Electronics Australia" does not publish, nor has available, lists of overseas stations, frequencies, broadcast schedules, etc. The only information of this type is compiled by our short-wave correspondent, Mr Arthur Cushen, and is published monthly in the "Listening Around the World" section.

For general information on short-wave and other stations, reference can be made to the "World Radio and TV Handbook". Revised each year, this book is available through most large technical booksellers or Mr Cushen.

NEW ZEALAND RADIO STATIONS

MEDIUM-WAVE STATIONS

KHz	Call	Location		Watts
570	2YA	Wellington		100K
630	2YZ	Napier		20K
640	4YW	Alexandria		2K
660	2YC	Wellington		60K
690	3YA	Christchurch		20K
720	4YZ	Invercargill		20K
750	3ZA	Greymouth	c	2K
760	1YA	Auckland		20K
780	4YA	Dunedin		20K
800	2YB	Wellington		20K
820	4ZA	Invercargill	c	10K
830	1YX	Whangarei		2K
840	2ZD	Masterton	c	2K
860	1YZ	Rotorua		10K
880	1YC	Auckland		10K
900	4YC	Dunedin		10K
920	3YZ	Greymouth		10K
930	1XW	Hamilton	p	2K
940	2ZA	Palmerston North	c	2K
960	3YC	Christchurch		10K
970	1ZN	Whangarei	c	2K
980	2ZB	Wellington	c	20K
1000	1ZD	Tauranga	c	10K
1020	1XP	Thames*	c	1K
1040	4ZB	Dunedin	c	10K
1060	2ZG	Gisborne	c	2K
1070	1ZB	Auckland	c	10K
1100	3ZB	Christchurch	c	10K
1130	2ZM	Wellington	c	2K
1140	1YW	Hamilton		2K
1150	2YX	Nelson		1K
1160	3ZC	Timaru	c	2K
1170	1XK	Te Kuiti	p	1K
1180	2YW	Gisborne		2K
1200	2ZW	Wanganui	c	2K
1210	4XO	Dunedin	p	2K
1220	1ZE	Kaikohe	c	2K
1240	1XX	Whakatane	p	1K
1250	1ZM	Auckland	c	2K
1280	2ZC	Napier	c	2K
1310	1ZH	Hamilton	c	2K
1340	2ZN	Nelson	c	2K
1350	1ZC	Rotorua	c	2K
1370	2ZP	New Plymouth	c	2K
1390	1ZT	Turangi	c	100
1400	3ZM	Christchurch	c	2K
1420	1ZO	Tokoroa	c	2K
1430	4XD	Dunedin	p	250
1440	1ZK	Kaitaia	c	2K
1460	3YW	Westport		2K
1480	1XA	Auckland	p	5K
1500	1ZA	Taupo	c	2K
1520	1ZU	Taumarunui	c	1K
1540	2ZE	Blenheim	c	1K
1560	2ZH	Hawera	c	1K
1590	1XI	Auckland	p.	5K

* Projected station.
c NZBC commercial station.
p Privately owned station. All except 4XD are commercial stations.
All other stations are NZBC non-commercial or part-time commercial stations.

SW SERVICE

Radio New Zealand is a short-wave division of the New Zealand Broadcasting Corporation, and operates two 7.5KW transmitters located at Titahi Bay, Wellington. The transmitting frequencies are varied as necessary to give optimum results.

The short-wave service relays programs from the national program on weekdays, and part of the 2ZB program on Sundays.

The present schedule was given in the December issue of "Electronics Australia" on page 125.

The "World Radio Handbook" giving details of all overseas stations is available in New Zealand through our short-wave correspondent, Mr. Art Cushen.

AUSTRALIAN TERRITORIES

Papua and New Guinea

In addition to the services on medium wave (9GR, 9LA, 9MD, 9PA, 9RB and 9WK) and on short-wave (VLK and VLT) provided by the Australian Broadcasting Commission, the Department of Information and Extension Services for the territory provides a number of short-wave stations as follows:

KHz	Call	Location	Watts
2410	9CG	Goroka	2K
2450	9CH	Mount Hagen	2K
3220	—	Lae	2K
3235	8AS	Alotau	10K
3245	8BK	Kerema	2K
3260	—	Madang	2K
3305	8BD	Daru	10K
3322.5	9BA	Kieta	2K
3335	9CD	Wewak	10K
3385	9BR	Rabaul	10K
5985	9RA	Rabaul	10K
6140	—	Wewak	10K

The Australian Administration Broadcasting Service also provides a service of news and information from the House of Assembly for relay by the regional stations throughout the territory.

KHz	Call	Location	Watts
11880	8BM	Port Moresby	10K.

Norfolk Island

A local service is provided by the Norfolk Island Administration under the technical direction of the Australian Post Office.

KHz	Call	Location	Watts
1570	2N1	Kingston	50

Lord Howe Island

The Department of Civil Aviation provides a service to inform residents of the arrival times of aircraft and shipping. Broadcasts are made one hour before the scheduled arrival time.

KHz	Call	Location	Watts
640	—	Lord Howe Is	50

PRODUCT REVIEWS AND RELEASES

Sony 1130 Stereo Amplifier

Over the past decade, as the performance of loudspeakers has been improved, their efficiency generally has been reduced. To compensate this, amplifier power ratings have risen. Continuing this trend is the high-quality Sony 1130 Stereo Amplifier, which has rated power output of 90 watts per channel at 0.1 per cent. total harmonic distortion.

To date, the Sony 1130 amplifier is the most powerful we have tested but it is still reasonably compact. Dimensions are 15¾(w) x 5⅛(h) x 12⅛ (d) inches while the net weight is a hefty 28lbs. 11 ozs. It is supplied complete with ventilated case for shelf installations and an optional mounting bracket is available for cabinet installation.

An aluminium extrusion with a fine satin finish forms the control panel of the amplifier. Along the upper part of the panel are six knurled knobs and one lever switch. On the lower section of the panel are five lever switches and one small knob. Two dual potentiometers provide the functions of volume and balance controls but rotary wafer switches are used for the tone controls, an unusual feature in today's amplifiers.

Input and Mode selection facilities are grouped on the right side of the control panel. A five-position switch provides for Mode selection while a three-position lever switch gives a choice of inputs — phone, tuner or the input selected by a 4-position rotary switch — phone 2, Aux 1, 2 and 3. The Aux 3 input is a stereo jack socket immediately below the latter switch. Next to the socket is the Tape Monitor switch.

One or both of two pairs of loudspeakers may be selected or muted by the 4-position switch on the lower part of the panel. Next to this is the stereo headphone socket. The other four switches not described are Power, Loudness, High and Low Filters. One feature of the switches was a little confusing — the Power and Loudness compensation switches are off in the down position, while the Filter switches are off in the up position. Apart from this, the control layout is very well thought out. The potentiometers rotate very smoothly and the switches are positive and free of backlash.

The rear panel of the amplifier accommodates finned heatsinks for the output transistors, six pairs of phone sockets and a DIN socket for the input facilities described above, plus an additional pair of phone sockets for control unit output and main amplifier input. These inputs and outputs are normally connected by a small slide switch adjacent to the sockets but they can be disconnected if an electronic cross-over and additional amplifiers are to be interposed.

Four pairs of spring-loaded loudspeaker terminals, three two-pin mains outlets and the fuseholder complete the list of rear-panel features. Incidentally, the mains fuse has a rating of 5 amps which would be suitable if the amplifier was running from 110 volts but offers little protection to the power supply components when running from 240 volts.

Removing the perforated steel cover reveals a neat chassis which is divided into three sections by two vertical steel plates running lengthways. The rear section is taken up by the large, well-shielded transformer and large electrolytic capacitors for the balanced positive and negative supply lines. The four heatsinks have an approximate T-cross-section with the power transistor mounted on the leg of the T while the fins protrude from the rear of the chassis. In this way, the high voltages applied to the output transistors are safely within the chassis, away from fingers or carelessly wielded screwdrivers.

Two large printed boards accommodate the power amplifiers, power supply and protection circuitry in the middle section, while the front section accommodates the controls and circuitry for the low signal level sections of the amplifier.

Circuitry in the Sony 1130 has several interesting, if not unique, features. The input preamplifiers for magnetic cartridges use an N-channel FET and a silicon bipolar transistor in direct coupled feedback pairs. Following this is the Mode selector, balance and volume control potentiometers. The tone control stage consists of no less than three FETs per channel in what appears to be a modified Baxandall configuration, but instead of using potentiometers as variable resistive elements in the feedback network, Sony uses rotary wafer switches to vary both resistance and capacitance.

This has the advantage that the "turnover" points of the tone controls are kept relatively constant for different orders of bass and treble boost. The use of switches also has the advantage that tonal adjustment can be applied in definite steps. For example, the treble control applies boost or cut in 2dB steps at 10 KHz and the bass control applies 2dB steps at 100Hz. In addition, there is no need for a tone control "cancel" switch to assure a flat frequency response when required.

Following the tone control stages are the muting sections, which consist of three bipolar transistors. These automatically mute the signal from the tone control stages when the amplifier is turned off and briefly, when it is turned on.

A fully regulated supply powered from a separate winding on the transformer provides the 40-volt rail for the small-signal stages. This gives the preamplifier stages more than adequate overload capability and assures low-distortion operation at all signal levels, regardless of the power delivered by the amplifier.

No less than ten diodes and eleven transistors are used in the basic power amplifiers for each channel. In addition to these are the semiconductors in the protection circuitry and capacitance-multiplier stages which supply power for the early stages of the power amplifiers. The basic amplifier circuit is the familiar quasi-complementary configuration with diode "linearising" in the driver stages. A differential input stage is used because of the balanced negative and positive supply lines.

A complex circuit protects the loudspeaker against damage due to transistor faults. The circuit samples the signal at the output via a low pass filter and bridge rectifier. Because of the filter, the voltage applied to the bridge rectifier is either very low frequency or DC. If a fault occurs in the amplifier, the voltage applied to the bridge rectifier becomes large and is sufficient to power a Hartley oscillator, the output of which is transformer coupled to a rectifier to trigger a thyristor. This turns on and removes all signals from the driver transistors so that all voltages are removed from the loudspeaker.

If one of the output transistors has become a short circuit, the protection circuit automatically forces the other transistor into second breakdown. This means that both transistors have to be replaced but output transistors are far less expensive than loudspeakers.

A completely separate protection circuit provides protection of the output transistors in the event of short-circuits to the output or excessively reactive leads. Sony appear to have left nothing to chance!

In operation, the amplifier was all that it should be. Background noise was virtually non-existent at all but maximum control settings and there were no clicks or pops from the loudspeakers as it was turned on and off. The tone control switches operated noiselessly, even at high gain settings. We did, however, find that the amplifier picked up radar pulses from Kingsford-Smith Airport, which is about 3 miles away. Admittedly these signals can be strong in a high-rise building such as ours, but from past experience the amplifier should not be quite as susceptible as it is.

On test, the amplifier met or exceeded all figures in its very comprehensive specification, except for intermodulation distortion which we were not able to check. Continuous power into 16-ohm loads was 56 watts into one channel or 49 watts per channel with both channels driven. Similarly, into 8-ohm loads, continuous power was 80 watts into one channel or 67 watts per channel with both driven. Into 4-ohm loads, it was 85 watts into one channel or 75 watts per channel with both driven.

At no time were we able to measure harmonic distortion in excess of 0.1pc which means that the amplifier easily met its rated power bandwidth specification of 7Hz to 30KHz. Even at very low power levels THD was considerably less than 0.1pc. Frequency response at a level of 1 watt was within +0 and —1dB from 10Hz to 100KHz, and tone control figures were right on the button.

Separation between channels was not as good as it might have been, which is perhaps why it was not mentioned in the specifications. At 67 watts into 8-ohms, it was —35dB at 1KHz with the undriven channel input unloaded. With the input loaded, the figure improved but at higher frequencies it decreased again. These figures were taken with the high level inputs. The phone inputs performed much the same. While the separation is certainly adequate it is not up to the standard set by the rest of the amplifier performance.

While the preamplifier has a maximum sensitivity of 2mV for full power the overload margin is very good — it will accept 80mV at 1KHz before overload occurs. A similar order of signal capability is available over the whole audio range. Signal to noise ratio for the phone inputs varies between —66dB for the unloaded condition to —72dB for the short-circuit condition. These

(Continued on page 103)

Canon Pocketronic Calculator

Using three large-scale integrated circuits, the Canon Pocketronic calculator performs the functions of much larger electromechanical desk calculators. Operating from nickel-cadmium batteries, it can be used in car, plane or office and the ¼in paper tape readout can be kept as a record of calculations.

Measuring just on 8 x 4 x 1-7/8 inches and weighing 1.8lbs the Canon Pocketronic will be a boon to businessmen who need a calculator for routine calculations while travelling on a plane or in a car. It would be equally suitable for desk use in an office since it requires very little space and is practically noiseless in operation.

Simple calculations such as addition, subtraction, multiplication, division and raising a number to a power are all performed easily. For addition the unit will give running totals and then carry on with further additions. Mixed calculations such as addition followed by multiplication may also be carried out. However since the unit has no memory chain multiplications must be carried out in separate steps.

Canon pocketronic and accessories.

Digit capacity is twelve operational digits both for calculation and result printout, with 8 digits to the left of the decimal point and four digits after. Negative results are indicated with a negative sign. In operation, all entries are read out on to the tape as the appropriate buttons are pressed. If the number of digits exceeds the capacity of the unit, it locks and prints out E for an overflowed entry and C for an overflowed result.

The thermal printout tape is supplied in plug-in cassettes packed with approximately 260 feet of tape, which is sufficient for up to 3000 calculations. Since the tape is heat sensitive it must be stored in a cool place. The operating temperature range is 0 C to 40 C (32 F to 104 F) so that it could not be used in some parts of Australia.

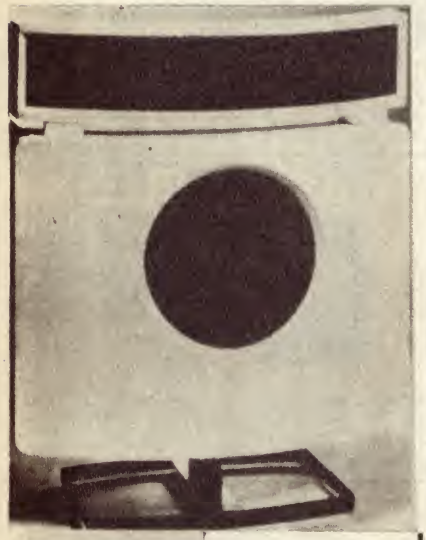
The internal batteries of the Canon Pocketronic allow up to 3 hours continuous operation when fully charged. In addition, when connected to the Canon 20A battery charger, it may be used with flat batteries after about 5 minutes wait. The battery charger takes about 3 hours to completely charge a flat battery and it may be left connected indefinitely as it has overcharge limiting. An indicator lamp on the charger tells when charging is complete. The 20A charger is housed in a plastic case measuring approximately 5 x 2 x 2¼ inches.

A smaller capacity battery charger, the model 10A, is also available. It takes 14 hours to completely charge the batteries and does not have overcharge limiting. Nor will it allow the Pocketronic to be used with flat batteries as will the model 20A. Swift & Bleakley Pty Ltd, who distribute Canon calculators, advise that an adaptor to enable the Pocketronic to be connected to a car's electrical system may be made available if demand warrants it.

Recommended retail price for the Canon Pocketronic calculator is $389.00 including sales tax. Retail price of the model 20A battery charger is $42.00. Further information regarding Canon calculators may be obtained from the distributors, Swift & Bleakley Pty Ltd, 149 Milton Street, Ashfield, NSW 2131.

Now! The Ecological Speaker! at the Convoy Technocentre of Sound

No sound pollution from B. & W. 70's. The revolutionary Electrostatic Monitor Now on demonstration.



The Continental (above) shown in the latest decor White with Black Trim. Also available in Walnut, Mayfair version left in teak or walnut.

What the critics say about B. & W. 70 electrostatic speakers

". . . approaching the ideal everyone is seeking — perfection", writes Mr. John Gilbert in the Gramophone, London.

"I was really astounded . . . a major breakthrough in Speaker design . . . the new models don't sound like loudspeakers at all. They sound like the real thing," says distinguished English Music critic John Freestone.

The B. & W. 70's are also available in kit form, and cabinet can be made to special designs or built in. Technocentre experts advise on technical requirements.

Also at Convoy the famous B & W DM3 speaker at 2 cu. ft. and the revolutionary DM1 miniature three-way monitor speakers, 0.65 cu. ft. from $130.00

J.B.L., U.S.A. Hear the L.100 Century speakers. See the Aquarius range of omni-directional speakers — surround yourself with superlative sound.

PEERLESS OF DENMARK. A superb 12" 3 way in Teak or Walnut only $220. pr. astounding value. Cameo 2 way $100. pr. best value.

McINTOSH OF U.S.A. America's most famous, 210 watts RMS Amplifier complete with Super Control Unit $2012. Other models from $760.

PIONEER, Japan. Best value for money in Amplifiers, Turntables, Speakers, 15 months Guarantee.

PHILIPS INTERNATIONAL HI-FI, HOLLAND. Europe's top Hi-Fi Equipment manufactured to din standards. A full range of this equipment on demonstration.

TEAC CENTRE FOR AUSTRALIA. A complete range of new TEAC semi-professional equipment on demonstration, fabulous AS100 Amplifier, reminiscent of valves. The Model 1230 Deck and the fully professional 7010 and 3300. Also professional quality TEAC Hi-Fi Cassette Deck from $183. The superb model A350 with Dolby and bias switch only $318.

TECHNOCENTRE SERVICE DIVISION.
We set up your tape recorder or deck for the correct bias to give you optimum from the tape you use. It will be like a new machine when set up for TDK-SD Tape. All repairs and service for Hi-Fi equipment.

FREE CUSTOMER PARKING

Convoy Technocentre

Where you hear and buy the world's top equipment.

Now at corner of Plunkett & Maclean Sts., Woolloomooloo, Sydney, 357-2444 (past Astor Motel).

PETER SHALLEY COMMUNICATIONS Pty. Ltd.

127 YORK STREET, SYDNEY 29-7021 29-3767

WALKIE TALKIE TRADE-IN MONTH

Let's get rid of all those illegal Walkie Talkies. Here's your chance to get real money back for those old sets that you are not really game to use. It's not worth risking a fine and confiscation. Your sets are worth real money if you trade in on the famous TOKAI range of equipment.

TOKAI TC502

★ 1 watt
★ all steel case
★ Sep. leather case
★ Ext. aerial con.
★ Ext. power con.
★ Mic input
★ Squelch

Nick cad bats AC adaptor base aerial

Price $97.00 ea.

TOKAI TC512

★ 300 MW
★ 11 transistor
★ Squelch
★ Tone call
★ Cow hide case Supplied
★ All metal const.

Price $70.00 ea.

We also repair and hire C.B. equipment

IVC-700 Videotape Recorders

International Video Corporation of Sunnyvale, California, have recently announced a new series of 1-inch helical scan videotape recorders, the IVC-700 series, which achieve new standards of performance at moderate cost. The machines are particularly well suited for educational and training applications.

The IVC-700 series is the latest addition to the International Video range of helical-scan VTRs. The machines are similar in appearance to, and fully compatible with, the existing higher priced IVC-800 and IVC-900 series machines. There are four basic models, ranging from the simplest playback-only configuration to that providing full record and playback with two audio channels and monochrome assemble editing.

The machines are available in either the portable format shown, or in an uncased form for rack mounting. The dimensions of the portable version are 65cm x 36cm x 27cm, and the weight 35Kg.

In standard form all machines in the IVC-700 series with the exception of the 701-PB playback only model are equally suitable for recording either high quality monochrome or colour. To replay PAL colour signals in colour an optional plug-in processor board is required, which can be fitted to any of the models in the field. The processor board is not required for replay of SECAM colour signals.

Rated video bandwidth of all models is 5.0MHz, and horizontal resolution 400 lines. Video S/N ratio is 41dB,P-P composite signal to RMS noise. Audio bandwidth is 75 Hz-10KHz for the main channel and 250Hz-7.5KHz for the second channel, with a S/N ratio of 40dB both channels.

The machines use standard 2.54cm helical-scan tape, accepting NAB spools up to 20cm diameter. Tape speed is 17.1cm/sec + 0.15pc, giving a maximum recording time of 1 hour. Starting time for a stable picture lock is less than two seconds for monochrome, less than 5 seconds for colour. Fast forward and rewind times are 120 seconds for a full 20cm spool. Tape motion is controlled by electrical pushbuttons, and may be modified easily for remote control using DC command signals.

A single head alpha-wrap format is used, with signal transfer to and from the head via a rotating transformer. The guaranteed head life is 1000 hours, a most impressive figure. The mechanical design of the machines is such that both mechanical and electronics servicing are facilitated by rapid access to all components. Video head replacement may be performed rapidly and without special tools or alignment jigs.

The performance, reliability and serviceability of the IVC-700 series makes them particularly well suited for use in educational and training applications. They would also be very suitable for use by advertising and marketing organisations.

Prices of the machines range from $1950 for the playback-only model, with the basic record/play machine $2250, and the most elaborate "2 audio channels with assemble editing" configuration $3900. The optional PAL colour processor is $1000. These prices do not include sales tax.

Further details regarding the IVC-700 series and other International Video VTRs and CCTV equipment may be obtained from their Australian representatives, Australian Video Engineering, whose head office is at 7 The Crescent, Annandale, NSW 2038. The Victorian office is at 622 Nicholson Street, North Fitzroy 3068.

One of the IVC-700 series 1-inch helical scan videotape recorders.

SONY AMPLIFIER . . .

figures are unweighted and very good for a unit of this complexity.

Square wave response of the amplifier was good at all settings of the controls. In general, the same remarks could apply for stability with various loads. However, we were able to induce instability at radio frequencies with or without signal applied, with capacitances in the range 0.01 to 0.02uF shunting an 8-ohm load and with treble boost. This situation is quite feasible in normal operating conditions, and thus warrants some attention from Sony.

We tested the short-circuit protection but did not try to simulate a fault condition inside the amplifier to test the loudspeaker protection. Apart from the minor points above, it is very hard to fault this amplifier. It is very well packaged and comes with a comprehensive manual printed in English, French and German. In addition, shorting plugs are supplied for the unused inputs to assure very low noise levels.

For the buyer who wants the ultimate in amplifiers and is not afraid to foot the bill, the Sony 1130 is certainly in the forefront. It has power to spare and performance that few amplifiers can match. Recommended retail price is $536 including sales tax.

The Sony 1130 amplifier and other products in the Sony range are available from retailers throughout Australia. Trade enquiries should be directed to the Australian distributors for Sony, who are Jacoby, Kempthorne Pty Ltd, 469-475 Kent Street, Sydney, NSW 2000. (L.D.S.)

PEAK

Superb new design, push button controls, 45 watts at 8 ohm (I.H.F.), 10-50k Hz (± 1db), distortion 0.2% (at 1w), 1.8mV mag. input, Sig. to Noise ratio 60db, tone, filter and loudness controls, damping factor 25 (8 ohms), full solid state circuit including IC's. Suitable for shelf or built-in type systems. C.B. protection.

Suggested retail price: $162.50

Of matching design to TRM-400, 15-15k Hz (± 1db), AM sensitivity 150uV/m, S/N 20db, AM Selectivity ± 10 kHz 25db, tuning meter, all silicon state circuit including FET's and IC's. Suitable for use with most Hi-Fi amplifiers.

Suggested retail price: $177.50

H. ROWE & CO. PTY. LTD

sole australian agents

adelaide brisbane
hobart melbourne
perth sydney

available from your nearest hi-fi specialist

HEWLETT-PACKARD RECORDER

Hewlett-Packard have released a multichannel oscillographic recorder which uses thermal styli and Z-fold paper instead of rolled chart paper.

Designated the Model 7414A Thermal Writing Recorder, the new unit has four channels and nine chart speeds ranging from 0.25 to 100 mm / sec. Frequency response is within +0.5dB from DC to 50Hz with 50 mm FSD, dropping to less than —3dB at 100Hz with 10 mm deflection.

One compact bench-top package includes the recorder mainframe and four plug-in signal conditioners. The full range of HP 8800 series plug-ins is available for use with the unit. Dimensions are 19(w) x 11-7 / 8 (h) x 24 (d) inches and weight is 95 lbs.

Inquires should be directed to Hewlett-Packard Australia Pty Ltd, 22-26 Weir Street, Glen Iris, Vic 3147, or 61 Alexander Street, Crows Nest, NSW 2065.

Dial Drives from John Carr & Co Pty Ltd

John Carr & Co Pty Ltd have in stock a range of dial drive drums, pulleys, springs and cords, some of which are pictured.

The dial drive drums are of plastic construction with brass ferrule and locating screws, to suit ¼in shafts. 10 sizes are available, with effective diameters from 30 to 108 mm.

Trade enquiries will be handled by John Carr & Co Pty Ltd, 405-411 Sussex Street, Sydney, while retail sales will be handled by Sun Wah Electronics, of the same address or Watkin Wynne Pty Ltd, 32 Falcon Street, Crows Nest, NSW 2065.

TRADE RELEASES — in brief

NATIONAL RADIO SUPPLIES, 332 Parramatta Rd, Stanmore, NSW 2048. A line of 8-inch **loudspeakers** of interest to hobbyists and others. The loudspeakers are unbranded but are actually imported Tesla units which have found their way on to the local surplus market. They are fitted with a seamless curvilinear cone exhibiting a natural resonance at about 90Hz and an upper frequency response which is good for a single

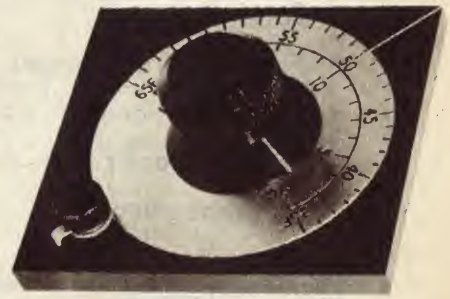
cone loudspeaker. Sensitivity is about average and voice coil impedance is 8 ohms. The quality of reproduction is smooth and pleasant and they would appear to be well suited for use in 2-speaker or 4-speaker line source systems for PA. in churches, small halls, &c. They could of course be used in modest stereo systems or for radios, TV sets, &c. The price is $4.75 ea.

HAGEMEYER (A'SIA) NV, 59 Anzac Parade, Kensington, NSW 2033. Agent for JVC America Inc., USA. **Control preamplifier**, model 5011 PST-1000, with sound effect amplifier (SEA) and graphic controls. This is a consumer unit incorporating the professional type SEA which enables a hi-fi enthusiast to control the response to compensate for variations in room acoustics and frequency characteristics of cartridges and loudspeakers. It has seven tone controls per channel, centred on 60Hz, 150Hz, 400Hz, 1KHz, 2.4KHz, 6KH and 15KHz, with independent adjustment of each.

The 5011 PST-1000 can accept inputs from magnetic, ceramic and crystal cartridges of high or low output as well as a tape head and microphone. Inputs at the Aux and Tuner terminals can be limited with separate 250K pre-set potentiometers to avoid distortion. Also available from Hagemeyer is the JVC 5012 MST-1000 power amplifier with a rating of 120W continuous power output.

SEECOM ELECTRONIC COMPONENTS, 34 East Parade, Mount Lawley, WA 6050. **Argo miniature locking dials.** The dials accept a standard 0.25in bore spindle, other sizes are manufactured to order. The standard dial has a backing plate 1in x 0.87in (2.54 x 2.21cm), is photoanodised, is graduated 0 to 10 over 300deg., and may be locked in any position over 360 deg. Special application dials are produced to customers' requirements: a typical example is shown in the accompanying photograph (right).

E. S. RUBIN & CO PTY LTD, 73 Whiting Street, Artarmon, NSW 2064, has opened a new office building on the corner of Woodville Road and Bower Street, Woodville, SA 5011. The manager is Mr. B. Hill. The company has purchased 11,200sq ft of land adjoining its present Artarmon building, and plans are well in hand for the building of extensions in early 1972. The scope of the Victorian branch office at Carlton will be widened; and a new Queensland branch will be opened in Brisbane this month. The company recently announced the appointment of Mr. T. H. Skelton, former NSW director of posts and telegraphs, as a director. E. S. Rubin has pioneered the development of non-switching unit (NSU) equipment in Australia. This



takes the form of multi-circuit consoles instruments which provide a wide range of telephone communication facilities.

SHARP ELECTRONICS (AUST) PTY LTD, 22 Burrows Road, St Peters, NSW 2044, is a newly formed wholly-owned subsidiary company of the Sharp Cor-

Like being proud of their Kangaroo, Sato's large variety of electrical parts is the favorite choice by Australians. Your inquiries are welcome.

SATO PARTS

SATO PARTS CO., LTD.

HEAD OFFICE: EBISU, SHIBUYA-KU, TOKYO, JAPAN TEL: (442) 8506~8
BANK ACCOUNT: MITSUBISHI BANK

A vast range of SATO Parts

- For manufacturers
- For TV
- For radio
- For instruments
- For amplifiers
- For kitset builders
- For sound equipment
- For industry
- For stereo equipment
- For educational purposes
- For electronics
- For tape recorders

Distributed by

GENERAL ACCESSORIES

AVAILABLE AT FOLLOWING BRANCHES:

46 Milligan Street, Perth.
116 Clarence Street, Sydney.
81-97 Flinders Street, Adelaide.
50-54 Lt. Edward Street, Brisbane.
443 Concord Rd., Rhodes, N.S.W.
153 Sturt Street, South Melbourne.
Cnr. Ingham Rd. & Echlin St., Townsville.
Homecrafts, Tas P/Ltd. 199 Collins St., Hobart.

poration of Osaka, Japan. It is also Sharp's regional headquarters in the South Pacific, covering Fiji, New Zealand, Tahiti, New Guinea, etc. Resident director and general manager is Mr. Jiro Nakata; the assistant-general manager is Mr. Warren Pegg (formerly with Olims Consolidated Ltd., in charge of Sharp products distribution); and the marketing manager is Mr. Peter Thorpe. The company's initial distribution will include electronic desk calculators, hi-fi stereo and tape equipment, domestic appliances including microwave ovens, and other electrical and domistic products.

BRITISH MERCHANDISING PTY LTD, 49-51 York Street, Sydney, 2000. Agent for the Digitran Co, USA. **Miniature thumbwheel switch, series 29000.** An economy model designed for rotary switch replacement, the unit is available as BCD, BCO 10

position with stops, BCD plus complement, single pole decimal, and single-pole double-throw repeating. Each module measures 0.35in (8.89mm) wide and 1.21in (30.73mm) high, with 0.2in (5.08mm) high characters. The switch is rated at 28V AC or 28V DC at 50mA at 25°C.

EMI (AUSTRALIA) LTD, 301 Castlereagh Street, Sydney, 2000. **Avalanche photodiode**, type S30500. Designed in the UK by EMI Electronics Ltd for stable operation near the avalanche breakdown region, the S30500 is suitable for use in systems such as spectrophotometers requiring improved red and near infrared sensitivity, and for fibre-line communications systems and laser-based range finding equipment. The diode's main features include: spectral response from visible region to beyond 1.1um; useful active area 0.5mm diameter; 90° field of view; rise time less than 1ns.

McMURDO (AUST.) PTY. LTD., PO Box 321, Clayton, Vic 3168. **Miniature connectors**, Redette range. These embody all the original design advantages of the Red range in only a quarter of the size. The Redette range consists of connectors of 16, 26, 38, and 52 ways. Sockets are fitted with floating bushes to assist alignment on back-rack applications. Plastic covers with cable entries and clamps for top and side entry are provided together with positive latches and plug protective shrouds.

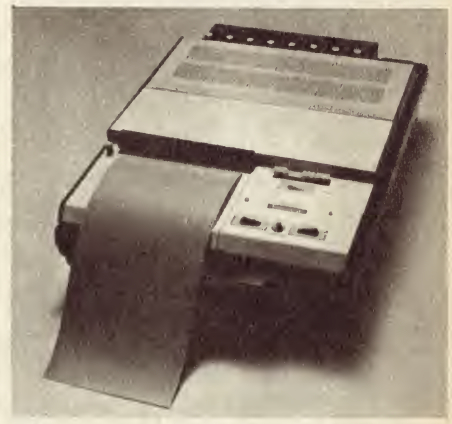
Pictured above is one of the special C&K switches which have been made available for the Sound Effects Synthesiser described in our October, November and December 1971 issues. The complete set includes 10 switches, suitably coloured, both locking and non-locking, as required for the project. The switches can be obtained through trade outlets or ordered directly on company order from Plessey Ducon Pty Ltd, Professional Components Unit, Christina Rd, Villawood NSW 2163. The price for the switches, including tax, varies with the exact type but should average something less than $2.00 each.

AURIEMA (A'SIA) PTY LTD, 549 Pittwater Road, Brookvale, NSW 2100. Agent for AVX, USA. **Monolithic capacitor arrays.** Using "Ceralam" multi-layer chip capacitors, these are available in 14-pin and 16-pin dual-in-line packages. Low-cost prototype quantities for evaluation are supplied with standard chip capacitors mounted in pre-formed packages. For production quantities, the entire capacitor array can be fabricated as a single monolithic structure with multiple connections attached to the lead frame, providing higher component density, lower cost and greater reliability. Chip capacitors are provided in capacitance values from 1pF to 1uF with voltage ratings of 25, 50 and 100V DC.

TEKTRONIX AUST PTY LTD, 80 Waterloo Road, North Ryde, NSW 2113. **Desktop calculator**, model Scientist 909. Aimed at satisfying the needs of engineers, scientists, statisticians and mathematicians, the 909 features: keystroke solutions in milliseconds; 10-digit readout accuracy with $10^{\pm 200}$ dynamic range; simple operation — one key programming; define functions — remember parameters; "Type" expressions — read answers; branching, loops and decisions with f(x) repeater. The device has only an on-off switch and mathematical push-button keys. Program reading and writing is simple and unambiguous, because there are no toggle or rotary switches to modify key functions. A simple access storage system handles up to 26 constants (100 optional) without reducing the programming capability. An f(x) key permits the storage of a special function written into the device by up to 85 steps (256 steps optional) — the function can then be used in future calculations by pressing a single key.

FAIRCHILD AUSTRALIA PTY. LTD., 420 Mt. Dandenong Rd., Croydon, Vic. 3136. **Solid-state six-digit numeric display**, type FND21. The unit, which features bright red numerals, has individual monolithic digits, with decimals after each, on a common ceramic substrate. The unit, encapsulated in a moulded red plastic package, can be plugged into standard DIP sockets or soldered to a printed wiring board. The FND21 is designed for multiplex drive applications only. Entirely IC compatible, the product houses six digits in less than 2in (5.1cm) panel space; requires less than 5mA per segment at 1.8V: has characters 0.122in (3.1mm) in height; is readable from 5ft (1.5m) away; and features a viewing angle of 160 deg.

SCHLUMBERGER INSTRUMENTATION AUST PTY LTD, PO Box 138, Kew, Vic. 3101. Agent for Schlumberger Instrument et Systemes, France. **Optical UV recorder**, model OM 4501, for the simultaneous recording from 1 to 8 parameters in cartesian co-ordinates. The traces are recorded on daylight printing paper, sensitive to ultra-violet rays, and are chemically developed following exposure to sunlight. The OM 4501 features plug-in voltage driven amplifiers with variable gain, high input impedance,



protection against overload, and easily calibrated against internal reference supplies. Recording may be carried out at any of eight speeds from 0.25mm/s to 1m/s with remote control facilities. Two sets of lines, one along the ordinate, every 5mm and in heavier print every 25mm, and the other on the abscissa in the form of a coded time base, permit visual definition of the cartesian references independently of the paper speed. A numbered identification spot discriminator allows each trace to be identified.

TECHNICAL BOOKS AND PUBLICATIONS

Microelectronics

INTRODUCTION TO MICROELECTRONICS, by D. Roddy. Published by Pergamon Press Ltd, Oxford, 1970. Soft covers, 5¾in x 8¼in, 151pp, many illustrations. Price in Australia $3.00.

This is a recent addition to the Pergamon Library of Industrial and Commercial Education and Training series. The author is Associate Professor of Electrical Engineering at Lakehead University in Ontario, Canada. The book is intended both for the college student and new graduate seeking further knowledge, and for the older engineer already familiar with discrete solid state circuitry who has to make the transition to ICs.

The text starts off with basic concepts concerning the solid state, proceeds through fabrication and basic devices and then deals with the various aspects of integrated circuit operation and application. This is well illustrated by the chapter heading: 1— Basic Semiconductor Theory; 2 — Processing of Silicon Devices and Circuits; 3— Silicon Planar Devices and Integrated Circuits; 4— Applications of Integrated Circuits I: Bipolar Logic Circuits; 5— Applications of Integrated Circuits II: Differential Amplifiers; 6— The MOST; 7— Applications of Integrated Circuits III: MOST Circuits; 8— Thin-Film Circuits; 9— Thick-Film Circuits; 10— Hybrid Circuits; 11— Microwave Applications of Microelectronics. The book ends with a topic index.

To this reviewer the text appears to be well written, presenting the essential concepts of microelectronics technology in a clear and concise fashion. The text is well supplemented by diagrams and photographs. The subject matter is fairly up-to-date, although some recent developments such as charge control devices, magnetic bubble technology and silicon gate MOS do not appear to be covered. This is perhaps inevitable with any book which attempts to cover a subject which is evolving so rapidly.

All things considered, a book which achieves its stated aims quite well, and thus one which should be found of considerable value by those keen to know more about microelectronics.

The review copy came from Pergamon Press (Aust) Pty Ltd, who advise that copies are in stock at all major bookstores. (J.R.)

Recording manual

MANUAL OF SOUND RECORDING. John Aldred. Second edition, 1971. Hard covers, 269 pages 8½ x 5½ inches, illustrated mainly by line drawings. Published by Fountain Press Ltd, 46-47 Chancery Lane, London WC 2.

This is the second, enlarged edition of a book originally published in 1963. The author is introduced as a man who has had long practical experience in sound recording — an activity that is followed by many people, using many mediums, for a variety of purposes. John Aldred's stated purpose has been to provide a book which can pass on some of his own practical experience.

There are 12 chapters altogether as follows: Basic Sound Principles — Basic Electrical Principles — Magnetic Recording and Reproduction — Disc Recording and Reproduction — Microphones — Amplifiers and Filters — Loudspeakers — Recording Studios — Music Recording — Stereophonic Sound — Motion Picture Sound — Microphone Techniques — Appendix, Index.

Quite a wide coverage, I think you will agree.

Unfortunately, closer study of the text on a random sampling basis, brought to light statements and implications against which I had to draw a query mark. I sought a second opinion from Jamieson Rowe and he reacted in much the same way.

For example, on pages 40 and 41 the role of HF bias in magnetic recording is explained, culminating in the phrase "distortion of the third harmonic is indicated". What an odd way to say that "third harmonic distortion is produced"! Other aspects of the explanation are likewise odd.

On page 44, in the context of recording, an upper frequency limit is said to be reached when the wavelength corresponds to the dimensions of the gap. The author seems to have confused the record and playback heads and, in fact, on page 52 he specifically says "the gap dimensions in the record head are not critical because the trailing edge . . . ." He also gives two seemingly unrelated definitions of demagnetisation, one on page 44, the other on page 53.

On the subject of disc recording he uses old-fashioned mono cutter diagrams in a generalised discussion of mono and stereo. He refers to a cutting stylus as being either steel or sapphire; what happed to diamond? The playback stylus is depicted as having virtually the same shape and dimensions as a cutting stylus, whereas the groove must see the playback stylus as the lower section of a sphere or a bi-radial equivalent. The reader is told that fine groove records are cut to 250 grooves per inch — only to learn later that groove spacing is commonly varied for a number of reasons.

When sample reading turns up points like these, the reviewer cannot but wonder whether they are symptomatic of problems elsewhere in the text.

In short, while the author undoubtedly meant well and planned well, there are signs that the text could have benefited by the attentions of a critical sub-editor. Our copy came direct from the publishers. (W.N.W.)

Solid state circuits

UNDERSTANDING SOLID STATE CIRCUITS, by Norman H. Crowhurst. Published 1970 by Tab Books, USA. Hard or soft covers, 190 pages 8½ x 5½ inches. Price in Australia $6.15 soft cover, $9.95 hard cover.

Countless books have been written with similar titles to this one but usually they have confused rather than educated the hobbyists to whom they have been directed. Mr. Crowhurst has had wide experience writing in the audio field and he brings this to bear in writing this volume.

Solid state devices, beginning with the diode, are introduced in the first chapter. Each device is treated like a "black box" which has certain voltage and current characteristics and the internal mechanisms are ignored. This appraoch is right in line with what the hobbyist wants — he is confused by what happens inside the device.

Other chapters go on to treat linear and power amplification and introduce such concepts as bias stabilisation, common base, common collector and common emitter amplifier stages, phase-splitters, complementary symmetry and protection. One chapter is completely devoted to feedback concepts such as gain stabilisation, equalisation and filter synthesis.

Two chapters are devoted to sinusoidal oscillators and function generators, and another to gain-controlled amplification. Perhaps the best chapter is the one devoted to control and logic circuits. Here, the reader is introduced to "open loop" and "closed loop" control in very simple terms and then to light dimmers, automatic control circuits and power supplies. A final chapter treats integrated circuits, both linear and digital.

The text is very well written and the author does not attempt to deal with too much material. He assumes a knowledge of basic circuit theory and then gives the "bones" of each concept without reference to mathematics or confusing technology. In short, a book which can be recommended to any hobbyist who wants to understand the basics of solid state circuit operation without going into it too deeply.

Our copy came from the Grenville Publishing Company Pty Ltd, who advise that copies may be ordered via all local bookstores. (L.D.S.)

Electron devices

BASIC ELECTRON DEVICES, by E. George Griffith. Published by Holt, Rinehart and Winston, Inc, New York 1971. Soft covers, 6in x 9in, 212pp, many diagrams. Price in Australia $3.95.

One may wonder if it is possible to do justice to the above title in just 212 pages. But the author does very well by limiting the discussion to bipolar transistors and diodes, and thermionic and gas tubes. Possibly a serious omission is the field-effect transistor.

The first two chapters deal with solid-state physics and the P-N junction. The first chapter describes the Rutherford and Bohr models of the hydrogen atom, electron energy levels, conductors, semiconductors and insulators, crystal lattices and so on. The second chapter gives a simplified treatment of the behaviour of a P-N junction.

Chapters 3 and 4 give a conventional treatment of the bipolar or junction transistor as a circuit element but there is very little analysis of the device itself, ie, the effect of bias, doping, majority and minority carriers and so on.

Chapters 5 and 6 deal with thermionic emission, vacuum and gas diodes. Again diodes are treated as circuit elements and the analysis of the devices themselves tends to be superficial. In similar vein, Chapters 7 and 8 treat triodes and other multigrid tubes. Chapter 9 discusses gas tube characteristics.

Apart from its major limitation in that there is no treatment of FET's, the book does provide an easily read text on the "basic" electron devices without any major excursions into semiconductor physics or field theory. As such, it would be a useful text for the more advanced hobbyist or student.

Our copy came from the local office of the publisher who advises that copies are available from major bookstores. (L.D.S.)

LITERATURE — in brief

HEWLETT-PACKARD JOURNAL, Vol 23, No 1, September 1971. Published by the Hewlett-Packard Co, USA. This is a special issue devoted to spectrum analysers. It contains the following articles: A fully calibrated, solid-state, microwave spectrum analyser, by Richard C. Keller; Tracking generators, by John Page; A low frequency spectrum analyser, by Irving H. Hawley, Jr; Hewlett-Packard spectrum analyser family, major specifications. Inquiries to Hewlett-Packard Aust Pty Ltd, 22-26 Weir Street, Glen Iris, Vic 3146.

AMALGAMATED WIRELESS VALVE CO PTY LTD, Private Mail Bag, Rydalmere, NSW 2116, has published a six-page catalogue of transistors and integrated circuits manufactured at the company's Rydalmere plant. It gives essential ratings and characteristics, dimensional outlines and pin connections. Copies are available free on request.

JACOBY KEMPTHORNE PTY LTD, 469-475 Kent Street, Sydney, 2000, has published a new catalogue covering the complete range of Sony products. In the form of a pocket-size hard cover ring binder, the catalogue illustrates each model in the range with its specifications. As new models are released, further leaflets will be produced and distributed to keep the catalogue up to date. Copies are available on request, under company letterhead, to hi-fi retailers.

AMATEUR BAND NEWS AND NOTES

by Pierce Healy, VK2APQ

The YRCS — Its Aims and Achievements

As a training scheme designed to introduce young people to amateur radio, the WIA Youth Radio Club Scheme continues to provide a valuable service to the community.

A prediction, that 1970 would see a healthy growth in YRCS activity, made at the end of 1969 by those associated with the scheme, has proved to be a fact. Although details have not been received from all states those to hand show that there has been a substantial increase in clubs registered. Also in the number of non-club members participating in the correspondence section.

In New South Wales, of 40 clubs registered, 14 joined in 1970. In Victoria some changes were made in administration, and there has been an increase in activities during the year. Rev. R. Guthberlet, State Supervisor in South Australia for several years, has been appointed Federal Co-ordinator. He succeeds Jim Webster who has been forced to curtail his YRS activities due to pressure of work.

During the past year these notes publicised the activities of YRS clubs and gave some details of the scheme. It was gratifying to receive requests for further information from persons interested in starting YRCS clubs. These inquiries came from students, school teachers, amateur radio operators and persons associated with parents and citizen organisations.

In New South Wales, the Institution of Radio and Electronic Engineers awards pennants each year to the most successful YRS clubs during the previous twelve months. Several business houses and commercial organisations donate prizes to be awarded to the most outstanding student.

Also, A number of business houses and manufacturers have donated components and other items to various clubs.

The certificates issued to successful candidates in the several examination levels are accepted, by prospective employers, as a positive indication of an applicant's aptitude.

During the past ten years many students have gained positions in the Postmaster-General's Department, the Department of Civil Aviation and the Overseas Telecommunication Commission.

Some details of the Youth Radio Club Scheme, which may assist interested persons to form new clubs, or extend the activities of existing ones, are as follows:

The objectives of the scheme are:—
(a) To develop in young people an interest in radio and electronics as a vocation or a worthwhile hobby.
(b) To provide school students with a hobby which will reinforce their school activities in science and mathematics.
(c) To assist leaders and instructors of youth radio clubs and non-club participants by providing ready made programs of activity.
(d) To co-ordinate the activities of youth radio clubs and non-club participants, and to promote co-operation and exchange of ideas among club leaders.
(e) To co-operate with schools and youth organisations in fostering youth radio clubs.
(f) To give encouragement and recognition to club members and non-club participants who attain certain specified standards of skill.

A series of Radio Proficiency Certificates has been developed to give a form of recognition to members who demonstrate that they have developed their knowledge to the standards specified. Certificates are graded at the following levels:—
(I) Elementary, (II) Junior, (III) Intermediate, (IV) Senior, (V) Advanced.

These Certificates are awarded in three grades, based on the marks gained in written examinations. From 70% to 79% is a "Pass Grade", from 80% to 89% a "Credit Grade", and from 90% to 100% is "Honours Grade."

For each certificate, candidates must construct, to satisfactory standards of workmanship and efficiency, various pieces of equipment. Many clubs arrange for kit sets to be available at a reasonable cost to members.

"Safety First" is emphasised very strongly from the outset. Practical projects for the Elementary and Junior Certificates must not be mains operated. The construction of power mains operated equipment for the Intermediate and higher certificates may only be undertaken when written permission has been received from candidates' parents.

An "Information Manual on the Youth Radio Club Scheme", prepared by the NSW Division, WIA, sets out in detail the aims, objects and syllabuses for the certificates. This is a most useful publication for those contemplating forming a club and affiliating with the scheme.

Further details may be obtained from the following officers in each state:—

Federal Co-ordinator: R. Guthberlet, 3 Hay Street, Kadina, SA, 5554.

New South Wales Supervisor: D. Jeanes, Unit 11, 35 Moruben Road, Mosman 2088. Secretary, J. Flynn, 30 Sharp Street, Belmore. 2192.

Victorian Supervisor: K. MacLachlan, 5 Masefield Avenue, Mooroolbark, 3138.

South Australian Secretary: A. Dunn, 18 McKinlay Street, Elizabeth Downs, 5113.

Western Australian Supervisor: L. Jessop, 17 Victoria Street, South Perth, 6151.

Queensland Supervisor: R. Everingham, 30 Hunter Street, Everton Park, 4053.

Tasmanian Supervisor: R. Emmett, PO Box 49, South Launceston, 7250.

Correspondence Section: W. Tremewen, 34 Flower Street, Ferntree Gully, Victoria 3156.

WIA ACTIVITIES

VICTORIA

The Eastern Zone of the Victorian Division WIA held a general meeting on the 30th October 1971. Peter Carter, VK3AUO, of the Zone's Lower Class Licensing Investigation Sub-committee, discussed the three schemes submitted to the Federal Executive Novice Licence Investigation Committee. One scheme proposes up to five grades of licences and the possibility of a hobbies grade preliminary licence requiring no Morse code or theory examination, only PMG regulations at AOCP standard.

Also being considered by the sub-committee is a sample type examination paper, from the Fed. Ex. committee, designed to cover the restricted or novice licence in common with the LAOCP and AOCP examination.

A resume of the work of the Eastern Zone sub-

Youth Radio Club Activities

VICTORIA

St John's College Radio Club was started in April, 1970. At present the membership is 60. Meetings are held on Wednesday afternoons from 12.30 pm to 1.50 pm for senior members and from 2.10 pm to 3.30 pm for juniors.

The Club station VK3BSJ is equipped with a Collins KWM2 transceiver, a Mosley MP33 Antenna and a Heathkit 610 monitor-scope. The antenna tower is 96 feet high.

A newly formed club is the Christian Brothers College YRCS club at Warrnambool. Club leader is Rev. Bro. Jim D'Orsa. It is expected that this will become a very active group.

WESTERN AUSTRALIA

St Benedict's Radio Club of New Norcia, under the leadership of Rev. Bro. Anthony, has registered with the YRCS.

Up till August, 1971, members of the Aquinas College Club had gained eight Honours, nineteen Credit and nineteen Pass certificates in the Elementary Certificate examinations.

In the Junior certificate examinations three Honours, three Credit and two Pass Certificates were won.

Certificates won by members of the Wesley College club were: — Elementary — One Credit and eight Pass grades. Junior Certificate — one Honours and one Pass Grade. Intermediate — one Credit grade. Senior Certificate — one Honours grade.

NEW SOUTH WALES

Maitland Radio Club

Production of MRC News, the club's excellent monthly news bulletin, is facing rising costs. A questionnaire was circulated to all members requesting their views on the problem.

Three members were successful at the August AOCP examination. Allan Mathews, qualified in telegraphy to gain his full licence. Ken Gormley and Reg Wood qualified for the AOLCP.

The Club is now equipped with high power VHF transmitters operating on the 146MHz and 52.525MHz FM nets. These will provide reliable communication within a 50 mile radius, and will also be available for WICEN operation in times of floods.

More than twenty members were awarded YRCS certificates in recent examinations.

Westlakes Radio Club

Ten members sat for the August AOCP examination. Of these eight were successful. They were, Eric Brockbank, Geoffrey Brown, David Griffiths, Wal Lean, Roger Parker, Kevin Scully, Garry Thorp and Glen Tickner. Nineteen YRCS certificates were awarded following recent Elementary and Junior examinations.

Following a police request on Saturday, 2nd October, 1971, the club station was placed on standby alert, Civil Defence frequency 3732KHz. Serious bush fires were threatening areas around Fennell Bay, Awaba and Cooranbong. The club was requested to listen for emergency traffic from Civil Defence base and mobile stations. The alert lasted for four hours.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, NSW 2200.

committee received from George Francis, VK3ASV, indicates the interest of members in the subject.

"A sub-committee was formed within the Eastern Zone in September 1970, to investigate the case for Basic or Novice licensing, to pass on proposals and recommendations to the Federal Novice Licence Investigation Committee. Reports made available by the sub-committee dated 6th November 1970 and 17th February 1971 were titled, 'The Case For Basic Licensing'. A further report dated 28th March 1971 was 'Suggested Standards For Granting Lower Class Licences'.

"The sub-committee met again on 31st July 1971 and the report of this meeting was published in the 'Amateur Radio' correspondence columns, October 1971".

An Education Fund has been set up within the Zone to promote amateur radio schools in the Gippsland area. At present three classes are being conducted at Warragul, Traralgon and Sale.

At the Hobbies Exhibition at Wonthaggi on 3rd November 1971, Alan Hyslop, VK3ZNB, set up an amateur radio station operating on 144MHz. Several interesting contacts were made, demonstrating to visitors the main emphasis of the display on the stand — "Amateur Radio as a worthwhile Hobby".

Members are planning to participate in the John Moyle Memorial National Field Day. It is intended to operate on all bands using the official station call sign of the Zone, VK3BEZ.

The Eastern Zone HF "Wildcat" DX Award rules have been amended to cover VHF DX applicants from outside the Zone for contacts made above 52MHz. This is to encourage VHF DX activity into the Zone.

To qualify for the award, five contacts are required with stations within the Zone. Applications must be accompanied by a certified log extract plus three IRC's. All contacts must be made after June 1st 1967.

Latrobe Valley Electronics Club

The Latrobe Valley Electronics Club was formed to promote the education of persons interested in radio and electronics the emphasis being on design, construction and operating techniques. Also, to involve members and their families in social activities within the club.

The club meets at 8.00 pm on the second Thursday of each month at the Trararalgon Tennis Club Rooms, cnr. Kay and Mabel Streets, Traralgon.

Membership is open to all persons with an interest in radio and electronics. Visitors are welcome.

President, Brian Corkoran	VK3YBD
Vice-president, Norman Longmaid	VK3ZQC
Disposals officer, Brian L. Young	VK3BBB
Secretary-treasurer, Max Crisp	——

Further details may be obtained from the Secretary, 84 Breed Street, Traralgon.

The club provides a service to members by way of disposal sales of components at reasonable cost.

A club newsletter is printed each month. Present membership is twenty and increasing each month.

Membership fees are:— Pensioners Free
Under 14 years 50c
Students $2.00
Full members $3.00
Family $5.00

Club activities during the past three months were; October — An interesting talk given by Mr. Geoff Atkinson of Fairchild Australia Pty. Ltd, who also screened a very good film on the manufacture of Fairchild integrated circuits.
November — Colour slides shown by George Francis, VK3ASV, taken on his recent trip with Keith Scott, VK3SS, to Central Australia.
The December meeting took the form of a Sunday picnic at Cowwarr Weir twenty miles east of Traralgon.

Geelong Amateur Radio Club

A Study Class which commenced in November is making good progress. Classes commence at 7.00 pm on Friday evenings. Further details may be obtained from the Secretary, Bob Wookey, VK3IC, telephone Geelong 21 2674.

It was expected that a transiator would be in operation from Mount Martha in December, and should cover Geelong for both base station and mobile use. The frequencies will be 145.854MHz in and 435.150MHz out. It will run one watt output to a ground plane antenna.

NEW SOUTH WALES

Hunter Branch Award

This certificate is awarded for outstanding performance in radio listening or two way com-

munication. To qualify, loggings must have been completed during any twelve month period, after 1st January, 1970.

Certificates will be awarded in five classes.

Full details next month.

Central Coast Branch

The officers of the Central Coast Branch of the N.S.W. division of the WIA for 1971 — 1972 are:

President	Frank Jarvis	VK2AFJ
Vice-president	Arthur Shoebridge	—
Secretary	Dick Maitland	VK2BBK
Treasurer	Bill Smith	VK2TS
Project Officer	Phil Levenspiel	VK2TX
Duty Officer	Fred Orvad	VK2AHX
PRO Officer	Jim Deller	—
Committee members	Leon Brett	—
	Frank Rose	—
Disposals Committee	Fred Orvad	VK2AHX
	Bill Smith	VK2TS
	Leon Brett	—
	Frank Rose	—

Meetings are held in the club rooms, Dandello Street, Kariong. A business meeting is held on the first Friday of each month. The third Friday of each month is devoted to technical lectures or some form of entertainment.

On the second, fourth and fifth Fridays AOCP classes are conducted by Ross Mudie, VK2ZRQ.

Work has commenced on the Central Coast, Channel 1 repeater, (146.1MHz in — 145.6MHz out) and approval has been granted by the PMG's Department for tests to be conducted.

The annual Field Day will be held on 20th February 1972 at the Gosford Showground. An invitation is extended to all amateurs and their families to spend a pleasant day at Gosford.

Program

8.45-10.30 am Registration —
Gentlemen $2.00; Ladies $1.00.
Children or full time students $0.50.
9.00-9.30 am Mobile scramble — in six sections:
a. High Frequency bands.
b. Six metre net
c. Six metre tunable
d. Two metre net
e. Two metre tunable
f. UHF bands
9.30-10.00 am Morning tea provided
10.00 am Disposal sale commences
10.00-10.45 am 7 MHz hidden transmitter hunt
10.15-10.30 am 144MHz hidden transmitter hunt for pedestrians
10.15-10.45 am Ladies throwing contest in two sections
a. Rolling pins
b. Radio unit
11.15-12.00 noon 144MHz hidden transmitter hunt.
11.15-11.45 am Ladies hat making contest (materials supplied)
12.00-1.30 pm Lunch provided
1.30 pm Quiz closing time
1.30-1.45 pm 144MHz hidden transmitter Hunt for pedestrians.
1.30-4.00 pm Visit to the Reptile Park or bus tour of Gosford area.
2.00-2.45 pm 144MHz hidden transmitter hunt for mobiles.
2.45-3.15 p.m. Afternoon tea provided.
3.10-3.40 pm Six and two metre nets. Combined map talk-in. (frequencies 52.525MHz; 146MHz).
4.00-4.15 pm 144 MHz hidden transmitter hunt for pedestrians.
4.15-4.30 pm Lucky dips.
4.30-5.00 pm Presentation of prizes.

Other attractions: Jam and cake stall; lucky door prize; quizzes; trade displays; amateur television; children's events; weaving display and demonstration; disposals (items submitted must be in before 9.45 am); liquid refreshments for young and old.

RADIO CLUB DIRECTORY

Published for the benefit of amateurs and enthusiasts who may wish to contact a club in their district, or while travelling on holidays.

New South Wales

Name: Hunter Branch, NSW Division, WIA.
Meeting Place: Technical College, Tighes Hill, Newcastle.
Date and Time: First Firday of each month at 8.00 pm.
Contact: Gordon Sutherland, VK2ZSG, 15 Marine View, Newcastle.

o o o o

Name: Westlakes Radio Club.
Call Sign: VK2ATZ.

Meeting Place: Club Rooms, 7 Anzac Parade, Teralba.
Date and Time: Monday, Wednesday and Friday evenings 7.30 pm., Saturday afternoon at 2.00 p.m.
Contact: Club Rooms telephone 58 1588; Secretary, PO Box 1 Teralba, NSW 2284.

o o o o

Name: Maitland Radio Club.
Call Sign: VK2BHV, VK2ZVM.
Meeting Place: Club Rooms, Maize Street, Tenambit, East Maitland.
Date and Time: Tuesday and Friday evenings at 6.30 pm; Saturday afternoon 1.30 pm.
Contact: Mrs. Margret Watson, secretary, telephone 33 7286 or Club Rooms, telephone 33 5680.

o o o o

Name: Wagga District Radio Club.
Call Sign: VK2WG.
Meeting Place: Civil Defence Building, Morrow Street, Wagga.,
Date and Time: Every Friday night at 8.00 pm.
Contact: Secretary, Leo McKenzie, VK2ZLU, 106 Ashmount Avenue, Wagga Wagga.

o o o o

Name: Illawarra Branch, NSW Division, WIA.
Meeting Place: No 1 Committee Room, Town Hall, Crown Street, Wollongong.
Date and Time: Second Monday of each month 7.30 pm, except when Public Holiday, Thursday is substituted.,
Contact: Secretary, Geoff Cuthbert, Telephone 4 0411, ext 80a; President, Basil Dale, telephone (home) 2 6847, (business) 4 0433.

o o o o

Name: St George Amateur Radio Society.
Meeting Place: Civil Defence Hall, The Mall, South Hurstville.
Date and Time: Normally, first Wednesday of the month at 7.30 pm, but may vary. Visitors should check with contact.
Contact: A Cutting, VK2AAC, telephone 587 0406.

Victoria

Name: Eastern Zone (VK3) Group.
Call Sign: VK3BEZ; VK3WI / R3-repeater, Channel 4.
Meeting Place: Normally at Traralgon.
Date and Time: General meetings four or five times each year, usually Saturday evenings. Details from secretary, Gavin Kuch, VK3ZNC, PO Box 175, Maffra, Vic 3860.
Contact: George Francis, VK3ASV, Publicity Officer, telephone Morwell 4 3953.

o o o o

Name: Geelong Amateur Radio-Television Club.
Call Sign: VK3ATL / T
Meeting Place: 2-10 Storrer Street (off Bourke Crescent) East Geelong.
Date and Time: Each Friday night at 8.00 pm.
Contact: R. B. Wookey, VK3IC, Secretary, 158 Kilgour Street, Geelong, telephone Geelong 21 2674.

o o o o

Name: Eastern and Mountain District Radio Club. Call Sign: VK3ER.
Meeting Place: Mooroolbark Technical School.
Date and Time: Last Friday of each month at 8.00 pm.
Contact: Alex Bell, Public Relations Officer, telephone 874 2523.

o o o o

Name: Western Suburbs Radio Club.
Call Sign: VK3AWS.
Meeting Place: 265 Elizabeth Street, East Coburg, Victoria.
Date and Time: First Friday of each month at 8.00 pm.
Contact: L. R. Johnson, VK3ZPB, secretary, 115 Mitchell Street, Maidstone, Victoria, telephone 317 9245.

o o o o

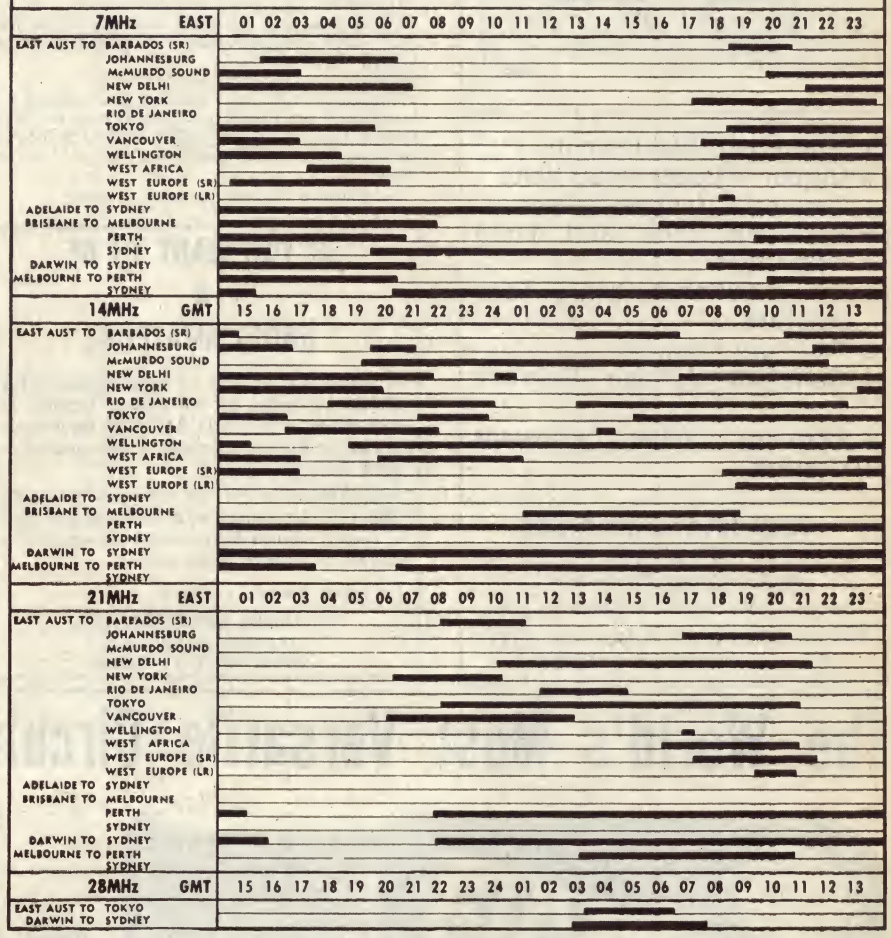
Name: Latrobe Valley Electronics Club
Meeting Place: Traralgon Tennis Club Rooms, cnr Kay and Mabel Streets, Traralgon.
Date and Time: Second Thursday of each month at 8.00 pm.
Contact: Max Crisp, secretary, 84 Breed Street, Traralgon Vic. 3844.

Queensland

Name: Ipswich and District Radio Club.
Call Sign: VK4IO.
Meeting Place: Club House, Deebing Street, Denmark Hill, Ipswich.

IONOSPHERIC PREDICTIONS FOR JANUARY

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). They have been prepared for the four most popular amateur bands over a number of interstate and international circuits. Black bands indicate periods when circuit is open. 1/72



Date and Time: Every second Tuesday at 8.00 pm.
Contact: Bill Jehn, 20 Hunter Street, Brassall, Ipswich, telephone 81 3629.

o o o o

Name: Redcliffe Radio Club.
Call Sign: VK4RC.
Meeting Place: 12A Savannah Street, Redcliffe.
Date and Time: Each Saturday 10.00 am-12.00 noon.
Tutorial Classes: Student members.
Contact: Dave Richards, VK4UG, 12A Savannah Street, Redcliffe.
Frequency Bands: 3.5MHz, 7.00MHz and 14.00MHz.

o o o o

Name: Central Queensland Branch, WIA.
Meeting Place: Club Rooms, Quay and South Streets, Rockhampton.
Date and Time: Third Friday of each month at 7.30 pm.
Contact: F. Roden, VK4FU, Secretary, telephone 64805.

o o o o

Name: Townsville Amateur Radio Club.
Meeting Place: Upstairs Auditorium, Radio Station 4TO, Ogden Street, Townsville.
Date and Time: First Thursday of each month at 8 pm.
Contact: R. Sayers, VK4ZRS, telephone 71 5348.

o o o o

Name: Bundaberg Amateur Radio Club.
Call Sign: VK4BW
Meeting Place: Club Rooms, Avoca Street, West Bundaberg.
Date and Time: First Wednesday of each month at 7.30 pm.
Contact: Lea Downing, VK4KX, telephone Bundaberg 71 3968 or J. McGrath, VK4JM, telephone Elliott Heads 35.

o o o o

Name: Sunshine Coast Amateur Radio Club.
Meeting Place: Kureelpa, located in the range west of Nambour.
Date and Time: Third Tuesday of each month at 8 pm.
Contact: Ken Chiverton, VK4VC, telephone 41 1324

NEW ZEALAND

Name: Eastern Suburbs Radio Club.
Call Sign: ZL1BLZ.
Meeting Place: ST Hilda's Church Hall, Mt Wellington, Auckland, 6.
Date and Time: First Monday of each month, 7.30 p.m.
Frequency Bands: 3.5MHz to 30MHz, 144MHz AM.
Contact: Phone 57 9175 or Box 62 042 Sylvia Park, Auckland.
Secretary: Mrs. E. Henry ZL1BIZ.

Remembrance Day Contest Results

The 1971 Remembrance Day Contest held last August was won by Queensland. Participation in comparison with 1970 was down despite the inclusion of New Zealand stations for the first time.

The final scores gained by each State were:—

Queensland	5886
South Australia	4341
Tasmania	3389
Western Australia	3268
New South Wales	3014
Victoria	1642

JOHN MOYLE MEMORIAL FIELD DAY

The Federal Contest Committee of the W1A invites all Australian amateurs and short-wave listeners to participate in this annual contest, which is held to perpetuate the memory of John Moyle, whose efforts advanced the Amateur Radio Service.

Date:

From 0600 GMT, 12th February 1972 to 0800 GMT, 13th February 1972.

Objects:

Operators of portable and mobile stations within all VK call areas will endeavour to contact other portable mobile and fixed stations in VK call areas and foreign call areas.

Rules:

1. There are two divisions, one of six hours and one of 24 hours duration. The six hour period may be chosen from any time during the contest, but the period must be continuous. In each division, there are six sections:—

(a) Portable / mobile transmitting phone.
(b) Portable / mobile transmitting CW.
(c) Portable / mobile transmitting open.
(d) Portable / mobile transmitting, multiple operator, open only.
(e) Fixed transmitting stations working portable / mobile stations, open only
(f) Reception of portable / mobile stations.

2. All Australian amateurs are encouraged to take part. Operators will be limited to their licensed power. For portable entries, power shall be derived from a self-contained and fully portable source.

(a) Portable / mobile stations shall not be situated in any occupied dwelling or buidling. Portable mobile stations may be moved from place to place during the contest.

No apparatus shall be set up on the site earlier than 24 hours prior to the contest.

All amateur bands may be used, but no cross band operation is permitted. Cross mode operation is permitted.

Entrants in Section (d) for multiple operator stations can set up separate transmitters to work on different bands at the same time. All such units of a multiple operator station must be located within a circle not greater than half a mile diameter.

For each transmitter of a multiple operator station a separate log shall be kept with serial numbers starting from 001, and increasing by one for each successive contact. All logs of multiple operator sations shall be submitted by the operator under whose call sign the transmitters are working. No two transmitters of a multiple operator station are permitted to operate on the same band at any time.

3. Amateurs may enter for any section.

4. One contact per station for phone to phone, also one for CW to CW per band is permitted. Cross mode operation will be accepted for scoring.

5. Entrants must operate within the terms of their licences and in particular observe the regulations with regard to portable operation.

6. For VK stations contacting VK stations, the exchange of serial numbers consisting of RS or RST report plus three figures commencing with 001 and increasing by one for each successive contact by the

VK station will be proof of contact. The exchange of RS or RST reports only with non-VK stations shall be sufficient proof of contact.

7. Scoring:

(a) Portable / Mobile stations:

For contacts with Portable / Mobile stations outside entrant's call area, 15 points;

For contacts with Portable / Mobile stations within entrant's Call area, 10 points;

For contacts with fixed stations outside the entrant's call area, 5 points;

For contacts with fixed stations within the entrant's call area, 2 points.

(b) Fixed Stations:

For contacts with Portable / Mobile stations outside entrant's call area, 15 points;

For contacts with Portable / Mobile stations within entrant's call area, 10 points.

Operation via active repeaters or translators is not allowed for scoring purposes.

8. The following shall constitute call areas: VK1; VK2; VK3; VK4; VK5; VK6; VK7; VK8; VK9 and VK0.

9. All logs shall be set out under the following headings: Date Time (GMT), Band, Emission, Call Sign, RST No sent, RST No received, Points Claimed. Contacts must be listed in numerical order.

In addition there shall be a front sheet showing the following information:—

Name..... Address.....

Call sign ..... Section.....

Division ..... (6 hour or 24 hour)

Points claimed.....

Call sign of other operators (if any) .....

Location of Portable / Mobile station .....

From..... hours to..... hours

A brief description of equipment used, followed by the declaration:

"I hereby certify that I have operated in accordance with the rules and spirit of the Contest."

Signed..... Date.....

10. The right is reserved to disqualify any entrant who has not observed the regulations and the Rules of this Contest, or who has consistently departed from the accepted code of ethics.

11. The decision of the Federal Contest Manager of the WIA is final and no disputes will be entertained.

12. Certificates will be awarded to the highest scorer of each section of each 6-hour or 24-hour division. Additional certificates may be issued at the discretion of the FCC. The six hour certificates cannot be won by a 24-hour entrant.

(An operator using 25 watts or less input to the final stage will be considered for a certificate where his activity warrants its issue.)

13. Return of logs: All entries must be postmarked not later than 6th March, 1972, and be clearly marked "John Moyle Memorial National Field Day Contest 1972", and addressed to:

Federal Contest Manager, WIA
Box 638 GPO, Brisbane, Qld 4001

Written comments are invited from all contestants.

Receiving Section

14. This section is open to all short-wave listeners in VK call areas. The rules shall be the same as for the transmitting section, but stations may omit the serial numbers received.

Logs must show the call sign of the Portable Mobile station heard, the serial number sent by it, and the call sign of the station being worked.

Scoring shall be on the same basis as for transmitting stations. It will not be sufficient to log a station calling "CQ". A portable mobile station may be logged once only for phone and once only for CW in each band.

Awards: A certificate will be awarded to the highest scorer of each of the 6-hour and the 24-hour divisions.

ITU NEWS

The International Telecommunication Union has published plans of a satellite TV experiment to promote education in India.

The project, named SITE (Satellite Instructional Television Experiment), will open a new era in space telecommunications. Under international agreement the Indian authorities, in collaboration with NASA, will be conducting SITE for a year from 1974 to 1975.

Objectives of the experiments will be to: (I) Make direct satellite TV broadcasting possible for the population of India; (II) gain experience in the development, testing and management of a satellite based instructional TV system, particularly in rural areas, and to determine optimum system parameters; (III) demonstrate the potential value of satellite technology in the rapid development of communications in developing countries; (IV) demonstrate the potential value of satellite broadcasting television in the practical instruction of village inhabitants; (IV) stimulate national development in India, with important managerial, economic, technological and social implications.

Within the framework of the UN development program the ITU is executing a support project for the development of terrestrial facilities. Transmission and reception of programs will be through the ATSF satellite now under development by NASA. It is scheduled to be launched in 1973, and will be shifted in orbit for the one-year SITE experiment with India.

The ITU is assisting in personnel training and the development of special TV receivers for satellite broadcasts. To test the system clusters of villages in different parts of India have been selected for trials. They will emphasise such problems as power sources, maintenance and operation.

The ITU has awarded a $200,000 contract to Hughes Aircraft Systems International for research and development into expansion of facilities at Ahmedabad, north of Bombay, where the experimental satellite communication earth station is located.

Mr. Richard E. Butler, Deputy Secretary-General of the ITU, indicated that the contract envisages a team of some 12 engineers, under the leadership of the ITU Technical Co-ordinator, providing research and development assistance for Indian personnel.

The ITU will be inviting offers for other services, especially for local research, development and manufacture of community TV receiving equipment.

With the implementation of this experiment, a new link will have been forged in the use of space techniques for the transfer of science and technology between nations, and the various multiplier benefits for economic and social development.

(Prior to taking up the appointment as Deputy Secretary-General of the ITU, Mr. R. E. Butler was an officer of the Australian Post Office.)

IONOSPHERIC PREDICTION SERVICE APPEAL

At the time of going to press there have been a number of VHF breakthroughs, mainly on six metres, and there are hopes that this will be a good DX season. The most consistent results seem to have been on the three consecutive days, Thursday, Friday, and Saturday, 25, 26, and 27 of November. Particularly during the afternoons and evenings of these days many stations were worked in VK3, VK4, VK5 and VK7. For much of the time the signals were at "blotto" level for long periods, particularly from VK4 and VK5, and many local VHF operators added impressive lists of call signs to their logs.

Interesting as these activities are as a purely amateur exercise, it is often overlooked that the information about them represents most valuable data for the Ionospheric Prediction Service, which is carrying out extensive research into all forms of long distance VHF propagation.

The Department has appealed for amateur assistance on previous occasions, and has often expressed its appreciation for the information which was forthcoming. They are now making another appeal, the details of which are contained in the accompanying letter.

Briefly, it means that over the next few years they wish to receive as many reports of VHF DX as amateurs can supply, over all paths but particularly trans-equatorial and from the mainland to Antarctica. To facilitate this, they are making available, on request, log sheets specially prepared for this purpose. Note particularly that it is not necessary to work a station in order to log it for this exercise. To hear it and identify it is sufficient.

This is an excellent opportunity for amateurs to justify their existence and build up some valuable goodwill at an official level. When the time comes for us to justify the existence of the amateur bands, evidence that we have contributed to a valuable research project, could well be sufficient to swing the decision in our favour.

So read the accompanying letter, get yourself some log sheets, and make your DX observations really mean something.

COMMONWEALTH BUREAU OF METEOROLOGY
DEPARTMENT OF THE INTERIOR

IONOSPHERIC PREDICTION SERVICE DIVISION

TELEPHONE 61 6791
TELEGRAMS: IPSO SYDNEY
TELEX: AA 20663

POSTAL ADDRESS: ASSISTANT DIRECTOR, IPS DIVISION, 162-166 GOULBURN ST, DARLINGHURST, N.S.W. 2010

OBSERVER'S NAME.....

Address.....

Equipment.....

.....

DATE	TIME CONTACT STARTED	STATION HEARD OR WORKED	FREQ & MODLN	REPORT SENT	REPORT REC'D	TIME CONTACT ENDED	FADING	REMARKS

Dear Sir,

The Ionospheric Prediction Service is currently carrying out research into unusual VHF propagation, with particular interest in transequatorial propagation and VHF propagation from Antarctica to Australia.

Reports from amateurs who have made VHF contacts via Sporadic E, transequatorial, tropospheric or ionospheric modes in the past two years would greatly assist us in our research.

We would also be assisted by log extracts and beacon observations giving times, dates, frequencies, call signs, signal strength and fading characteristics, plus such notes as when the signal first appeared and when it disappeared, or whether it was on when first observed and still on when observations ceased.

Alternatively report forms and detailed explanations can be obtained from:—

Roger Harrison,
Ionospheric Prediction Service,
162-166 Goulburn Street,
DARLINGHURST. NSW 2010

Reports should also be sent to the above address.

Two types of propagation are of particular interest at present, viz: VHF transequatorial propagation and VHF propagation between Antarctica and Australia. VHF propagation via Sporadic-E on the Australian mainland will also be investigated for its own sake and in relation to the other two types of propagation in the near future.

There are a number of beacons that can assist in observations and indicate openings, these being JA1IGY in Japan (51.995MHz), HL9WI in Korea (50.100MHz), KH6EQI (50.101MHz) and KH6ERU (50.015MHz) in Hawaii. These beacons will indicate trans-equatorial openings to the north and north-east.

Two beacons are located on the Antarctic mainland. VK0MX (52.525MHz) at Mawson and VK0PF (53.839MHz) at Casey. A beacon is also located at the Sub-Antarctic base at Macquarie Island, VK0TM (53.032MHz).

We have received a number of confirmed reports of the beacons JA1IGY, HL9WI and WB6KAP being heard in the last twelve months. It would greatly assist our research if reports of these beacons being heard, over the past year and in the future, could be submitted to the above address, along with reports of any contacts to the areas of interest.

Yours Sincerely,
Roger Harrison.
For Assistant Director,
Prediction Branch.

MICROWAVE NEWS

Details of experiments on 10,000MHz and the equipment used by Des Clift, VK5CU, were given in the September issue of these notes. Mention was also made of equipment under construction. News from Des indicates that by the time these notes are published the new equipment will have been used in further tests. Also, 3300MHz equipment has been constructed and tests are being planned.

Des also advises that, during the microwave contest held in late September in the United Kingdom, a two-way contact was made on 10,000MHz over a distance of 150KM (93 miles) by a group consisting of G3RPE, G3ZGO, G3BNL, G3EEZ, G8APP and G5FK. Signals were readibility five and strength nine each way. The equipment was not unlike that described in the September notes, and used a three-foot dish antenna at one end and a four-foot one at the other. The stations were in Prescelly in Pembrokeshire and Dartmoor.

SERVICEMAN from p.58

I imagine I shall have to bide my time until the set needs service for some other reason, then quietly restore it to its proper condition.

Serviceman's note: The above story is particularly interesting, inasmuch as one very like it was written up in these pages several years ago. Those interested, and particularly my contributor, may like to refer to it. The story proper was in December 1962, with follow up comment in June 1963.

The story created quite a controversy at the time. There were two schools of thought regarding the cause of failure. One maintained that it was due to flashover in the video amplifier, the other (mainly from within the diode and valve industry) that it was due to signal overload of the diode, particularly during the warm up period before the AGC became operative. This condition, in turn, was due to selection of a diode, against the manufacturer's advice, with too low a peak inverse voltage rating.

In this regard it is interesting to note that the diode involved in the current story, OA90, has the same peak inverse rating as the one in my original story (OA80) namely 30. At that time the diode manufacturers recommended either an OA79 (45V) or, better still, an OA81 (115V). So, it would appear that the argument has not yet been settled.

NOTES & ERRATA

PLAYMASTER 132 STEREO AMP: (July 1971) p36; Three points on the circuit board layout should read as follows: "Mode switch L & R" connections should be "Mode switch R & L", "Left Treble Max" fourth from RHS should be "Left Treble Min". On p37, the stabiliser / protection circuit board shows a 68 ohm 3 watt resistor in the lower left corner. This should be a 39 ohm 3 watt in accordance with circuit diagram and parts list. If readers have installed a 68 ohm resistor, there is no reason to change it, as its purpose is to provide current limit for TR28 under short circuit conditions.

CAPACITANCE METER: (March 1971, File No 7/CM/5.) On page 45, centre column, second paragraph, the reference transistor is quoted as a BC109. It should be a BC108, as noted on the circuit diagram.

MARLUX Cassette Recorder (reviewed November 1971): In reference to the review on page 113, the distributors make the following statement: "While the manufacturer states an output of 1 volt, in the majority of cases 150mV is an optimum level that suits most amplifier inputs. It is true that at the 1 volt level, distortion would be as reviewed. However, at 150mV, the distortion is well within tolerances for use with any high quality sound system." Signed V. Ross, for International Dynamics (Agencies) Pty. Ltd.

LISTENING AROUND THE WORLD

by Arthur Cushen, MBE

Signals from Europe — our six-monthly survey

Our six-monthly survey of transmission from Europe shows that although the sunspot count is falling, high frequencies are still being widely used. During our summer months, signals from Europe are best received during the hours of darkness.

ALBANIA: Radio Tirana has many transmissions in English mainly in the 41 and 31 metre band. Reception is best at 0630GMT on 7060 and 9500KHz. Another service at 2100GMT is on the same frequencies.

AUSTRIA: Broadcasts from Vienna are beamed to the Pacific area in a two hour transmission from 1000 to 1200GMT on 17785KHz. English is used in several 15 minute sessions. Reception is good at 0730GMT on 6155 and 7245KHz. The Austrian Government announced recently that they would possibly close the shortwave service from Vienna at the end of 1971. Definite information is not yet available, but the current transmission schedule is valid until March.

BELGIUM: English from Brussels is in two transmissions at 2305 and 0050GMT on 9550 and 15255KHz, which are best received in our winter period. Best reception from Brussels is at 1000GMT when a program is beamed to Africa in French and Dutch, on 21460, 21475, 17815, 15325KHz.

BULGARIA: Radio Sofia transmissions to Europe give fair reception with an English broadcast at 1930GMT on 6070 and 9700KHz. A further program is 2130—2200GMT, on 7670, 11765, 15310, and 17825KHz.

CZECHOSLOVAKIA: Radio Prague has a transmission in English 0700-0800GMT, on 6055, 9505, 11780, 15310, 21690, 21700 and 11780KHz. An English broadcast for morning reception is at 1930GMT on 5930 and 7345KHz. The service to North America also provides fair reception 0300—0400 on 5930, 7345, 9540, 9630 and 11990KHz.

DENMARK: Radio Denmark has no English programs at present, but the government recently announced plans to restore its former international short-wave service. Transmissions from Copenhagen open and close with English announcements. The present schedule is 0730-0815, 1130-1155, 1200-1245, 1330-1345,1400-1445, 1600-1645, 1730-1815, 1830-1915 and 2000-2045. all on 15165KHz.

FINLAND: Helsinki opens in English at 1000GMT on 15185KHz. This gives the best reception at this time of the year. Another transmission on 9550 and 11755KHz has English news Monday to Friday at 0625GMT. The broadcast which includes the English news is 0555-0630GMT weekdays. On Sundays the transmission is 0630-0655 and is in Finnish and Swedish.

FRANCE: ORTF in Paris has several English news bulletins of 15 minutes duration in the overseas service. Best reception is 0515GMT on 7155, 7255, 9700, 11920 and 11930KHz. Another service, beamed to Africa, gives good reception 2015-2100GMT on 15295, 17720 and 21580KHz. A transmission in French is beamed to the Pacific on 6175 and 9620KHz, 0600-0700GMT.

EAST GERMANY: Radio Berlin International broadcasts to the Pacific area in English 0645-0715GMT on 17700KHz; also at 1200 and 1330GMT on 21540KHz and at 1330GMT on 17700KHz.

WEST GERMANY: Deutsche Welle at Cologne has two daily transmissions in English to Australia and New Zealand. These are 0920-1020GMT on 11795, 15185, 17800 and 21560KHz; and for morning reception 2100-2200GMT on 7130, 9765 and 15275KHz. A transmission in German to the Pacific is 0700-0910GMT on 9650, 11795, 17845KHz.

GREAT BRITAIN: The BBC World Service is available 24 hours a day in English and for most of this time reception is possible in this area. The transmission schedule appears on this page from time to time and is at present as follows:

GMT	KHz
0545-0915	7150, 9640, 11955, 15070
0900-1115	11750, 15070, 21470
2000-2245	7120, 9410, 11750

HOLLAND: Radio Nederland is heard through its relay station at Bonaire in transmissions in English and Dutch to Australasia as follows:

GMT	KHz
0630-0750	11730 (English)
0630 0750	9715 (Dutch)
0800-0920	9715 (English)
0800-0920	11785 (Dutch)

HUNGARY: Radio Budapest has a special transmission to the Pacific on Wednesday at 0800GMT on 21685, 17795, 15160, 11910KHz. A service to Europe at 2000GMT is on 21665, 17890, 11910, 9833, 7220, 7100, 6110 and 6025KHz. A service in English to North America also provides reception 0400-0430GMT on 21685, 17840, 15165, 11910, 9833, 6165 and 6175KHz.

ITALY: Rome has a news bulletin in English for listeners in the Pacific at 2200GMT on 5990, 9710 and 11905KHz. A program in Italian for listeners in Australia is 0600-0645 on 9575, 11810, 15330, 17795 and 21560KHz.

NORWAY: Oslo broadcasts to the Pacific daily at 0700 and 1100GMT. On Sundays at 0800 and 1200 there is a broadcast in English for 30 minutes on the following schedule:

GMT	KHz
0700-0830	11850, 15175, 17775, 21655, 25900
1100-1230	21655, 21670, 21730, 25900

POLAND: Radio Warsaw has English transmissions to the United Kingdom and several of these provide good reception in this area. Transmissions are on 9675 and 7125 0630-0700GMT. Other broadcasts in English are at 1830, 2030 and 2230GMT.

PORTUGAL: Radio Portugal broadcasts to the Pacific 0730-0900GMT on 17885 and 21495KHz. Another transmission, beamed to North America, provides good reception at 0345-0430 on 11935 and 15125KHz. Several other organisations use transmitters in Portugal; these include Radio Free Europe and Trans Europe, The Trans Europe transmitters carry programs for Deutsche Welle, CBC, IBRA and the Voice of Hope programs.

ROMANIA: Radio Bucharest, Romania has a daily service to the Pacific from 0645GMT, on 11940 and 15250KHz. A further channel, 17850KHz, is announced, but has not been received. English broadcasts to North America at 0430-0500 are well received on 9570, 9590 and 11940KHz.

SPAIN: Radio Nacional Espana in Madrid has an English transmission to North America which gives good reception 0100-0345GMT. The latter portion of this transmission can also be received on 9760KHz. Transmissions in Spanish to South America are 2300-0500 on 9360, 11775 and 15145KHz. Another service is on 9520KHz 0100-0700GMT. A relay station on the Canary Islands broadcast 2100-0600 on 11800 and 15365KHz.

SWEDEN: Radio Sweden has a daily service to Australia and New Zealand This is in English 0515-0545GMT. The transmission has been scheduled on 9585KHz, but because of interference it is expected that a new frequency will be put into use shortly. Another service to this area is 2045-2115GMT on 9745KHz. Radio Sweden broadcasts in English 11 times a day and transmissions beamed to most parts of the world can be received.

SWITZERLAND: The Swiss Broadcasting Corporation at Berne has two transmissions for this area in English. These are part of a program broadcast 0700-0915GMT. English is at 0700 and 0845, for 30 minutes each, on 9590, 11775, 11865 and 15305KHz. A further English transmission from 1100GMT is on 15430, 17795, 21520 and 21585KHz.

USSR: Radio Moscow, through its relay station in Siberia, has English programs for the South Pacific 1100-1130GMT on 15400, 12060 and 7280KHz. From 1200 to 1230GMT the program is carried on 15400, 12060, 12070 and 5960KHz.

VATICAN: Vatican Radio now has three transmissions in English to Australia and New Zealand:

GMT	KHz
0730 (weekday)	11740, 15330
1125 (daily)	17800, 21485
2210 (daily)	7250, 9615, 11705.

YUGOSLAVIA: Radio Belgrade has been heard with English news at 1830GMT on 6100 and 7240KHz. Another English program is at 2000GMT on the same frequencies. This is repeated at 2200 and carried on the additional frequency of 9620KHz.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. All times are GMT. Add 8 hours for WAST, 10 hours for EAST, and 12 hours for NZ.

NZ DX LEAGUE CONVENTION

The annual convention of the NZ Radio DX League will be held this year at Invercargill over the Easter Weekend. Activities will include discussions, listening and social activities. Interested readers can obtain further details from Arthur Cushen, 212 Earn Street, Invercargill, NZ.

Broadcast Band News

AUSTRALIA: Recently two Australian stations which for many years have been relays of a metropolitan program have been given their independence and are now operating as full time stations. Station 3LK, which relayed 3DB on 1090KHz for some 35 years, is now operating its own program from studios at Horsham, Vic. Likewise 4SB, which from Kingaroy, Qld., relayed the programs of 4BC Brisbane for over 33 years, now has its own program on 1060KHz.

The recent frequency change by 3CV Maryborough, Vic, to 1060KHz, resulted in an upgrading of the station equipment according to the Manager, Mr. Ken J. Parker. Mr. Parker said "We have erected two quarter wave vertical aerials, each 240ft high, complete with new earth mats, to be used in conjunction with our existing mat. The old vertical aerial is half-way between the two new ones, and all earth mats have been linked together for greater efficiency. We have also erected a new transmitter building and, with several other improvments, I think we can claim to have one of the most modern transmitting stations in Australian country radio."

NEW ZEALAND: Radio Otago, Dunedin commenced broadcasting on November 20 on 1210KHz with 2KW on a 24-hours-a-day basis. We verified this station on its initial tests when running only 700 watts. The station confirmed our reception with a card and a window sticker. The station has a new address: PO Box 1210, Dunedin. This is the fifth private commercial station to open in New Zealand in the past year, and the 55th radio station now in operation in New Zealand.

NEW!

LPS INSTANT COLD GALVANIZE . . .

equals hot-dip galvanizing at 1/2 the cost

Available in 16 oz. Aerosol spray-cans

LPS Instant Cold Galvanize is a ready to use 95 p.c. PURE ZINC compound that provides long-lasting protection from rust and corrosion.

LPS Instant Cold Galvanize is NOT A PAINT! When applied to iron or steel it generates a positive electric current that flows to the base metal. This electrochemical action fuses the zinc compound with the metal. Corrosion will attack only the outer zinc coating leaving the metal to be protected rust free. If coating is penetrated LPS Instant Cold Galvanize will sacrifice itself to protect the exposed base metal. RUST CANNOT SPREAD.

USES:

LPS Instant Cold Galvanize should be used wherever metal is exposed to corrosive conditions such as in the construction and maintenance of:

AUTO & TRUCK BODIES	RAILROADS	TRAILERS
FARMING EQUIPMENT	WATER TANKS	FENCING
MARINE EQUIPMENT	MOTOR BIKES	OIL RIGS & PIPE LINES
METAL ROOFS & FLOORS	TV AERIALS	STRUCTURAL STEEL
MINING EQUIPMENT	SNOWMOBILES	LINES & TOWERS
OFF-SHORE STRUCTURES	GOLF CARTS	UNDERGROUND EQUIPMENT
POWER PLANTS	PATIO FURNITURE	LAWN & GARDEN EQUIPMENT

AIR CONDITIONING, HEATING, & REFRIGERATION SYSTEMS

TECHNICAL INFORMATION:

Passes **PREECE TEST** for hot-dip galvanizing
SINGLE APPLICATION THICKNESS – approximately 1½ mils
COVERAGE – approximately 50 square feet per pound

TOUCH DRY – 1 minute . . . can be painted over in 6 hours or 30 minutes after baking at 350° for 15 minutes

WITHSTANDS:

- Over 3,000 hours in salt spray cabinet
- Water temperature above boiling point
- Continuous dry heat up to 750° F.
- Short period heat up to 1000° F.

SPECIFICATIONS:

LPS Instant Cold Galvanize meets or exceeds the following specifications:

MIL - P - 46105 weld thru primer
MIL - P - 21035 Galvanizing repair (U.S. Navy)
MIL - P - 26915A for steel (U.S. Air Force)
MIL - T - 26433 for towers (Temperate and Arctic Zones) (U.S. Air Force)

Complies with Rule 66-3 Los Angeles and San Francisco

LPS Instant Cold Galvanize provides maximum protection when applied to clean, dry metal.

LPS RESEARCH LABORATORIES, INC.
2050 COTNER AVE. • LOS ANGELES, CALIF. 90025 (213) 478-0095

Distributed by

ZEPHYR PRODUCTS PTY. LTD.
70 BATESFORD ROAD, CHADSTONE, VICTORIA
Phone: 56 7231

NEW RH (Radio House) RANGE OF MULTIMETERS

"HANDYMAN"

CHECKED PACKED & POSTED FREE

RH150 $11.50

Pocket-size 3¼" x 4½" x 1¼".
Instruction sheet and circuit.
SPECIFICATIONS:
DC Volts: 2½, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: .1, 25, 250mA.
Resistance: 20K and 2M.
Decibels: —20db, +62dB, 0.7KHz.
Capacitance: .0001, .01, .0025, .25uF

MODEL RH-100 $39.75. Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

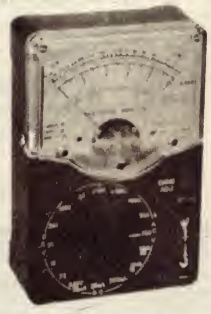
• Overload protected by dual silicon diodes • Double-jewelled ± 2 per cent meter • ± 1 per cent temperature-stabilised film resistors • Polarity changeover switch • Mirror scale • Instructions for operation with circuit diagram.

SPECIFICATIONS:
DC Volts: 0.6, 3, 12, 60, 300, 600, 1200 (100,000/V).
AC Volts: 6, 30, 120, 300, 1200 (10,000/V).
DC Current: 12A, 300A, 6mA, 60mA, 600mA, 12 amps. AC Current 12 amps.
Resistance: 20K, 200K, 2M, 20M.
Decibels: —20 to +17, 31, 43, 51, 63.
Accuracy: DC ±3 per cent. AC ± 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

MODEL RH-20 $13.95. Postage 50c

20,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current, 50uA, 25mA, 250mA.
Resistance: 7K, 700K, 7M.
Decibels: —10, +22 (at AC/10V) +20, +36 (at AC/50V). Upper frequency limit 7KHz.
Batteries: Two 1.5V dry cells.
With overload protection $15.00.

MODEL RH-55 $20.00. Postage 50c



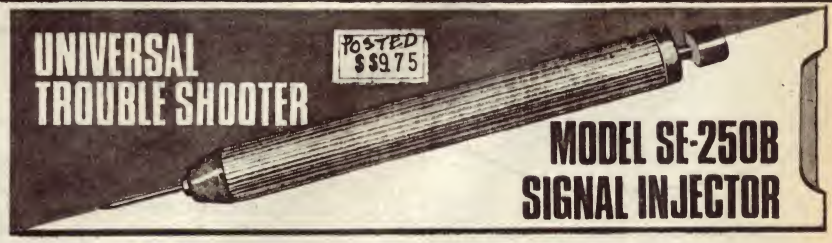
30,000 Ohms per Volt DC
14,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V
AC Volts: 12V, 60V, 300V, 1200V.
DC Current: 60uA, 12mA, 300mA.
Resistance: 10K, 1M, 10M.
Decibels: —10dB, +23dB.
Overload protected.

MODEL RH-80 $18.00. Postage 50c.

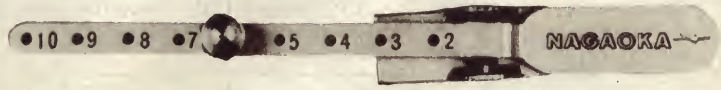
20,000 Ohms per volt DC.
10,000 Ohms per volt AC.
Specifications:
DC Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5M.
Decibels: —10dB + 62dB.
Accuracy: DC 3pc.
AC 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

• Overload protected by dual silicon diodes • Double-jewelled ± 2 per cent meter • ±1 per cent temperature-stabilised film resistors • Mirror scale.

As featured in Electronics Australia October 1971, the two-station Edison Intercom.



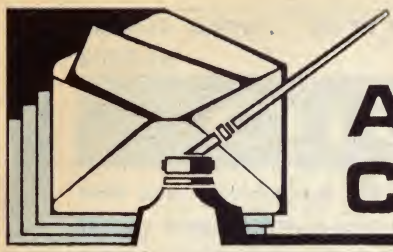
STYLUS PRESSURE GAUGE, Balance type NW-501



$1.50 Posted

RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171



ANSWERS TO CORRESPONDENTS

CLOCK SWITCH: Congratulations on a very comprehensive and first-class magazine. I wish to construct a radio alarm clock using a microswitch and the mechanism of an alarm clock to operate a transistor radio. I wish to insert a jack into the radio so that when the plug is out, the radio operates normally. Can you tell me if there is any danger of damage to the radio if power is disconnected by this switch while the volume control is still turned up. Also, what is meant by the term "Solar Radio". (U.N., Sydney, NSW.)

There should be no danger of damage to the radio using a device such as you envisage. In fact, this idea is quite a popular one. On your other question, a "Solar Radio" is simply a normal radio which uses a silicon solar cell to convert light from the sun into electricity to power the radio.

ECHO UNIT: I have been searching for circuit diagrams of an echo unit other than a spring delay-line type, a reverberation plate or a tape unit. I require a unit that possesses a variable delay time with a natural echo that I can use in conjunction with a PA system and other musical systems. (M.H., Brisbane, Qld.)

There appears to be a popular misconception among a section of our readers, namely that it is possible to produce an audio echo effect by purely electronic means. Unfortunately, we know of no way in which this can be done and, while it might be presumptuous for us to say that it cannot be done, we will go so far as to say that it is impractical at the present state of the art. What's more, we would suggest that anyone who can come up with a practical solution will make a lot of money. In the meantime, M.H., we are afraid you are going to have to settle for one of the systems you have nominated, or go without, for we know of nothing else.

NOVICE LICENCE: I am interested in obtaining my novice radio licence, Could you please tell me how to contact the relevant authorities, and the titles of suitable books to study for this exam. Have you published the plans of a simple CW transmitter of under 75W power? (E.R., Broken Hill, NSW.)

There is no novice licence available in Australia at the present time. Some plans are in hand to bring this about, but it may be some time yet before it is a reality. The Radio Branch of the PMG's Department, in your nearest capital city, can advise you regarding the present amateur licence requirements. For study guidance we suggest you contact the Youth Radio Scheme Division of The Wireless Institute of Australia. The address is 14 Atcheson St, Crows Nest, NSW. Some of the amateur transmitters we have described in the past would probably satisfy the requirements you stated, but we suggest you wait until you have more background in the subject before making a decision along these lines.

INFORMATION SERVICE CHARGES: Have you noticed the revised charges for our Information Service? If not, please consult the panel below.

SIX-VOLT CDI SYSTEMS: I was pleased to read in the November 1971 issue the article on a six-volt CDI system but disappointed to find no reference to "positive chassis" vehicles. There are many such vehicles on the road, my own included, and modifications to suit these would be very welcome. (E.B., Earlwood, NSW.)

We are surprised at your statement that there are still many six-volt positive-chassis vehicles on the road. Apart from Volkswagens, all other car manufacturers (as far as we know) had changed to 12-volt systems by late 1957. This fact alone means that there are very few such vehicles on the road. Other readers may care to comment. If there is sufficient reader interest we may be able to publish details for "positive chassis" systems.

CAPACITY: Can you please explain how the capacity of a capacitor works, and how to work out the code on them. Also, I would like to know where I could get a circuit of AMF mine detectors, or any other metal locators. (J.B., O'Connor, ACT.)

We are not sure what you mean by the "capacity" of the capacitor. If you want to know how a capacitor works, then we suggest you have a look at the fourth chapter of the Home Study Course (August 1971) entitled "Capacitors and Capacitance." The different codes used are too numerous to cover here, but the majority of Australian capacitors have their actual value stamped on them. If in doubt, we suggest you use these types. We do not know where you would be able to obtain a circuit for an army mine detector, but we published a design for a metal locator in the January, 1970 issue. Reprints are available through the information service (File No. 3 / MS / 20).

PROXIMITY SWITCH: Can you tell me the material used for the sensor plate for the proximity switch described in the June, 1971 issue? Have you ever published a tone control for an 8-ohm loudspeaker, as I would like to incorporate one in my mono tape recorder? (P.L., Fawkner, Vic.)

The sensor plate can be made from virtually any metal. Sheet aluminium, steel or zinc would probably be the easiest to acquire. Tone control circuits are normally part of the integral design of audio circuits, rather than the loudspeaker. All of those which we have described have been part of either an amplifier, a control unit or a complete tape recorder.

Q MULTIPLIER: Can you tell me what a Q multiplier is used for, and have you published circuit for any? Do you intend to publish a circuit for a light beam transmitter and receiver that uses modulated light to transmit from one point to another, using light bulbs and photocells? (T.H., Rostrevor, SA.)

A "Q multiplier" is any circuit which can be added to an existing circuit to improve its Q. The subject was covered in the article "Q Multipliers" in our April, 1969 issue, (File No. 2 / IF / 7), available through the Information Service for 50c. We do not have on file any circuits for modulated light beam transmitter / receiver units using light bulbs, but we did describe a system based on a gas laser in the October, 1969 issue (File No. 2 / MS / 19).

SIMPLE AMPLIFIER: I am a beginner in electronics and I am trying to build a simple stereo amplifier with tuner, but I have no circuit. Could you make up a circuit for me with some of the parts in the list I have attached. (N.W., Highgate, SA.)

Sorry N.W., but we do not design circuits for readers. However, we published a basic stereo amplifier (File No. 1 / SA / 24) in June, 1966 and a basic tuner (File No.

"ELECTRONICS AUSTRALIA" INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer. (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2) A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 50c per project. Prior to December 1959, circuits and diagrams only are available. From December 1959 onwards, complete articles are available. No material can be supplied, additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 30c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by seperate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects. Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1 These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply negative transparencies, actual size. Price: 50c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 10c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 50c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia. Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified.

ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 2728, GPO Sydney, NSW, 2001.

— (10/71)

2/TU/26) in July, 1968 which might meet your requirements. Both are designed to use components salvaged from old receivers. Copies of these articles may be obtained through the Information Service for the usual 50c fee.

INDEX OF PROJECTS: Have you ever published an index of projects, etc. If not, would it be possible in some future issue as I am sure it would be very handy to readers. (R.F., Hermit Park, Qld.)

We publish an annual index in each March issue. Copies of all indices from Volume 17 are available through the Information Service for 50c each.

HORN LOADING OF LOUDSPEAKERS: Can you supply me with any information you have on horn loading of loudspeakers? Can any type of loudspeaker be used, or does the term horn loading just refer to the box. Do you have any information about this type of box, concerning construction and loudspeaker mounting, also the type of loudspeaker suitable for the construction? I gather that efficiency is the most significant feature of this type of construction, but is the quality of the sound affected at all by horn loading? (B.J., Tullamarine, Vic.)

You appear to have a basic misconception about horn loading. With this type of construction the loudspeaker feeds its acoustic energy directly into a large horn, the dimensions of which conform to a precise mathematical formula. In practice, this means that for adequate bass response the structure is much too large for the domestic situation, and this type of system is usually found in auditoriums and theatres. Where space and cost are not a significant factor, the horn loaded loudspeaker is used because of its excellent efficiency and sound reproducing qualities. However, in the domestic situation, vented or sealed enclosures are normally preferred. All loudspeaker systems described in "Electronics Australia" are of these types.

MODEL CONTROL: Have you ever published a description of a radio control unit for model aeroplanes. (P.J., Golburn, NSW.)

We published a radio control system for modellers in two parts (Files Nos 3/MC/3 & 4) in December, 1965 and January, 1966. A 27MHz superhet receiver using an IC (File No 3/MC/5) was published in February, 1970. Copies of these articles may be obtained through the Information Service for 50c each.

GUITAR AMPLIFIERS: I congratulate you on a very interesting and helpful magazine. Have you ever published circuits for a 100W or 150W guitar amplifier? If so, where can I obtain a copy of the circuits? Where can I get a copy of a handbook containing names and addresses of amateur radio operators in Australia and other parts of the world? Are there any radio clubs in my area? (S.G., Horsham, Vic.)

We have not published circuits for guitar amplifiers as powerful as you suggest. We described a 60W valve type guitar amplifier in the July, 1967 issue (File No 1/GA/9) and a 50W solid state version in the July/August 1969 issues (File Nos 1/GA/17-18). If these are acceptable, we can supply project reprint material through the Information Service for 50c each article. For names and addresses of amateur operators and information on radio clubs, write to the Wireless Institute of Australia, PO Box 36, East Melbourne, Vic 3002.

CB TRANSCEIVERS: May I add my congratulations to those of others for a very well presented magazine. The only disappointment I have in the magazine is that I do not find articles on CB transceivers. Could you describe to me a suitable balun for the 27MHz CB. Is there a way of eliminating interference to TV reception caused by transcievers? What special requirements are needed to use CB transceivers in the amateur bands? (P. B., Carnarvon, WA.)

Strictly speaking there is no "citizens' band" in Australia. The 27MHz band is available for certain private users of radio communications equipment, provided they are in possession of a licence from the Postmaster-General's Department. Licences are normally granted to persons having a genuine need for radio communication over short distances. All transmitting equipment used for communication in this or any other bands, except that designed for the amateur bands, must be type-approved by the PMG Radio Branch. Since it would not be practical for individual constructors to obtain approval for their equipment, we do not describe transmitting equipment other than that designed for amateur use. It should be noted that it is an offence to operate any form of transmitter without an appropriate licence from the PMG's Department. Only licensed amateurs are permitted to use the amateur bands. Interference to TV reception by 27MHz equipment should be reported to the PMG Radio Branch. Officers of the Department will advise what steps should be taken.

SMALL ORGANS: I am interested in building a small electronic organ similar to that used by Rolf Harris. Do you have circuits of this and of more advanced designs such as chord organs? Do you know of any suppliers of kits of the above? (W. van B., Napier, NZ.)

We have published an article describing a keyless electronic "organ" similar to that requested in the Jan. 1969 issue. Reprints of the article are available from this office for 50c each, under file number 1/EM/19. We have not described a chord organ or similar polyphonic instruments except a single manual one. Parts for the latter are not easily obtainable these days, and venturing into construction is not advisable. A few of our kitset advertisers would probably carry kits of the former, and an enquiry should be directed towards these people.

STATIONS LIST: I wrote to the NSW Radio Branch of the Australian Post Office asking if they had information about NSW radio stations and their areas of coverage. They suggested that I write to Electronics Australia for this. Can you help? (J.F., Guildford, NSW)

In the January issue each year we publish a list of all radio and TV stations in Australia and New Zealand. The list includes location, power, and frequency. However it does not show effective coverage.

RADIO: Unofficial history

You seem to accept items of "unofficial history" connected with communications generally and not only radio, so perhaps the following will be of interest.

The public telephones in use during the magneto era signalled the manual operator that his/her request "insert two pennies please" had been obeyed, by the rapid make and break of the local microphone/battery circuit within the telephone, caused by the two pennies vibrating a pair of contacts which they bumped on their way down to the coin box.

I was serving my "switching experience" as part of my technical training at the old Ryde magneto telephone exchange in Sydney, when a dear old soul rang in from a public telephone. I obtained the wanted number and before connecting, gave the time-honoured request "insert two pennies please!"

I heard the signal, connected the number and was just about to tell the dear old soul to "go ahead please" when she, somewhat anxiously, reported "I've just put them in — they'll be along at the Exchange in a minute!"

I also remember another dear little old lady (or so she sounded) who used to ring regularly on certain days and ask for the same number each time — I can remember the number now after 35 years I heard it so often —

I was so intrigued after a number of such calls my curiosity got the better of me, and next time I listened in:—

L.O.L: "Is that you Bill?"

Bill: "Yes, Kate"

L.O.L: "I want 2/- each way on . . ."

I had led a fairly sheltered existence up to that stage and the incident wrecked my faith in the moral rectitude of little old ladies.

Readers are invited to submit contributions to "RADIO: Unofficial History" and a publication fee will be paid for those used. Stories must be humorous and they must be true. Letters must be signed and the locale of the story indicated as a mark of good faith. The Editor reserves the right to rephrase contributions as necessary to preserve uniformity of style

SOUND PROJECTORS
Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.
from $115.00

CIRCULAR SLIDE RULE
3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.
from $1.25 each
Post 12c.

P.M.G. TYPE TELEPHONES
Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.
$25.00
(2 TELEPHONE SETS)
30c. cartage to rail. Freight payable at nearest attended railway station. Please note we are now able to include ¼ mile of twin telephone cable FREE with each set of phones.

BATTERY CHARGERS
240 volt AC Input
Each battery Charger will charge either 6 or 12 volt batteries.
2 amp without meter $15.75
2 amp with meter $17.75
Post N.S.W. 95c.; Interstate $1.20.

MINIATURE ELECTRIC MOTORS
1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only
65c. each or 10 for $4
(Post 12c.)

TRANSCEIVER
(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54MHz F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100KHz; step 10 channel per MHz with power supply, mike, and headphones. $45. 60c. cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER
(2-way radio) 62 set, 12V, operation. Ideal Hams, etc. 1.6 to 10MHz. Crystal locked or VFO controlled. 5 watt output. Complete with antenna, headphones and mike. $60. 30c. cartage to rail. Freight payable at nearest attended railway station.

HEADPHONES
Low impedance moving coil fitted with rubber muffler to reduce external noise, fitted with press to talk, dynamic hand microphones. Ideal for use with all types of transceivers. $3.50 pair.
Post N.S.W. 45c.; Interstate 65c.

COLLINS TRANSCEIVERS
Auto-tuned 100-150MHz. 10 channels.
$65.00

HALF-INCH RECORDING TAPE
Top grade 2400' on 10½" reels. Ideal video experimenting. Only $1.50 per reel.
Post N.S.W. 45c.; Interstate 75c.

LAVOIE HETERODYNE FREQUENCY METERS
10-100MHz. LA5 $250.
100-500MHz. $350.

ADLER FREQUENCY METER
100KHz-20MHz. $175.

4 DIGIT RELAY COUNTERS
50-volt DC, suit slot car. Lap counters, etc.
$1.25 each. Post 18c.

NIBBLING TOOL
Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7/16-inch.
ONLY $6.50
Post 74c.

NIFE CELLS
1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.
$1 each.
Post N.S.W. 25c. Interstate 35c.
3.6V 10AH, set of three batteries in wooden holder, $7.50 per set or $2.50 per battery 1-2 volt 10AH.
Post N.S.W. $1.10; Interstate $2.72.

WALKIE-TALKIE TWO-WAY RADIOS
P.M.G. Approved Citizen Band. 9 Transistor $55.00 per set of 2.
Post N.S.W., 74c.; Interstate 85c.

P.M.G. TYPE KEY SWITCHES.
45c each. Post 24c.

45 x 40 coated Lens with tripod.
$10.95
30 x 30 Power Coated Lens. Brand New.
$3.75.
WITH TRIPOD $4.50
50 magnification with a 60mm coated objective lens.
With tripod.
$26.20
As illustrated.
Postage $1.20; Interstate $1.45.

BC221
Frequency Meters.
$55.00

SMALL COMPUTER PANELS
.3in x 2in containing 2 valves, qty. of resistors, etc.
ONLY 75c.
Post 24c.

STEREO headphones, brand new.
$5.75
Post N.S.W. 95c.; Interstate $1.20.

TYPE S POWER SUPPLY
(240 V / AC supply for AT 5-ARB). Suit most types of Disposal transmitters and receivers. Outputs 250 volt, 10mA, 550 volt 200mA, 300 volt 100mA. $30.

TELEPHONE WIRE
21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin, $7 per coil.
Post N.S.W. 95c.; Interstate $1.45.

CO-AXIAL SWITCH
70 ohms, 4 positions.
Can be motor driven, completely waterproof, 70 ohms type connectors. Housed in metal case 9in x 8in x 8in, $5 each.
Post N.S.W. 95c.; Interstate $1.45

ELECTRONIC COUNTER
(Austronic) 0-100KHz. 240V operated.
$150

Cossor Double Beam Oscilloscope 1035. Tested.
$150

VALVES
BRAND NEW
IN CARTONS
Special discount for quality

807	75c	CV850	$1.50
65N7GT	95c	1H6G	30c
8989	$1.00	832	$5.00
5U4G	95c	6AK5	$1.50
EF50	35c	6X4	$1.00
SY3	$1.75	12SK7	50c
6C4	50c	VR65	25c
2 x 2	75c	VT4C	75c
6AG5	80c	AU5	$1.00
12AU7	$1.00	80	$1.25
X61M	$2.20	6AK5W	$1.50

Please add postage on all articles

HAND BEARING BOAT COMPASS
Brand new, complete in wooden carrying case with strap and batteries. Illuminated with magnifying prism. $36.50 Post NSW $1.00 Interstate $1.20.

TELESCOPES
30 x 40 with Tripod.
$7.95
Post N.S.W. 95c; Interstate $1.45

CHASSIS PUNCH SET
Five sizes: ⅜-inch, ¾-inch, ⅞-inch, 1-inch and 1⅛-inches. With taper reamer.
$7.50
Post, $1.15

SELSYN MOTORS MAGSLIP Mk. II..... $5.25 ea.
No. 19 TWO-WAY RADIOS. Power supply, accessories, etc., $35.

BINOCULARS
PRISMATIC. Coated Lenses. Brand new. Complete with case.

6 x 30	$12.50
8 x 30	$18.75
7 x 25, wide angle	$29.50
7 x 50	$22.15
10 x 50	$23.07
12 x 50	$23.95
20 x 50	$29.50

Post N.S.W 95c; Interstate $1.45.

3000 TYPE RELAYS
P.M.G. 200 Ohms — 1,500 Ohm Coils. $1.25 each. Post 24c.

TOGGLE SWITCHES
Brand new, 3 amp, 240 volt. S.P., S.T. 39c each or 10 for $3.
Add postage.

Cintel Oscillator and Electronic Counter, type 388. $250.

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2. We haven't got time to sort them, so you reap the benefit.
Post 75c.

CONDENSER LENS
1½in diam. 1½FL. 50c each.
Postage 24c.

MINE DETECTORS
Ex A.M.F. with Instruction Book. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station. $39.00

ALTEC STUDIO MICROPHONES
639B Western Electric, top grade. Original cost $250, Ideal Broadcast Studio, music recording. Church and play recording, etc.
Fraction of original cost.
Price on application.

SPECIAL PURCHASE TOP GRADE RECORDING TAPES
Brand new, from well-known maker. Sorry, we cannot divulge brand name. 7" x 2,400' Mylar in plain carton.
Only $3.50 ea. Post 35c.

SOLENOIDS
Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio. etc.
$1.25. Post 24c.
200 MA 24 volt, ⅛in push movement.
$1.25. Post 24c.

CONDENSER LENS
2½in DIAM. 2in FL. $1.50 each. Or $2.50 per pair. Post 24c.

ZOOM FOCUSING MICROSCOPE
Battery and mirror illuminated. 900 x magnification, complete with dissecting kit slides, etc. $17.95.
Post N.S.W. 90c: Interstate $1.20.

TEN CHANNELS VHF TRANSCEIVER
Types TR 1934 100-125 MHz and TR1935 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator. $33.00

RECORDING TAPES
TOP QUALITY, BRAND NEW

		Post
3" x 150'	65c	12c
3¼" x 600'	1.58	13c
5" x 900'	1.95	13c
5" x 1800'	3.62	13c
7" x 1200'	3.18	24c
7" x 2400'	4.80	74c
7" x 3600'	6.45	74c

CASSETTE TAPES
C60 $1.15; C90 $1.75; C120, $2.25
Post 13c.

Crystal Earphone 75c

Cassette head cleaners $1.95

Small Lapel Microphones, ea. $1.25
Post 24c.

Pocket multimeters AC volts. 15-1000 DC volts 15-1000. DC current 150 milliamps. Resistance 100,000 ohms. Price $6.95. Post 74c.

BYER 77 Mk. 1
Rack Mounting Tape Recorder ex A.B.C. 7½-15 ips. Full track tested $150.

Microphone. Professional S.T.C. type 4017. $20.

Marconi Video Oscillator type TF885A 0-12 MHz. $75.

A.W.A. SIG GENERATOR
UHF 140-300 MHz $65.00

Pye 4 Channel Crystal Locked Oscillator, 1.5-30 MHz New. $25

TRANSPONDER APX6
with Lighthouse Tubes. Can be converted to 1200 MHz. $17.

WHEATSTONE BRIDGE
Top grade.
In Multiples up to 1,000. $65.00.

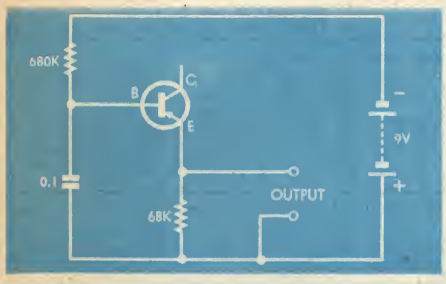
Deitch Bros.
70 OXFORD STREET, SYDNEY 2010
SORRY, NO C.O.D.

TRANSISTORS . . . cont. from p. 77

The answer is — to make noise! But why should we want to make noise — isn't there enough of that around already?

The noise we are trying to make is rather special. It is known as "white noise", which may be defined as sound within the audio spectrum which is completely random in frequency and amplitude. The name is borrowed from white light, which is also random mixture of frequencies and amplitudes within the visible spectrum.

White noise has a unique property. It is able, to some extent, to mask sound by increasing the "ambient" noise level to which the ear becomes accustomed. In other words, the ear's sensitivity is



Circuit for white noise generator.

decreased. The end result is that you become less conscious of all but the louder sounds.

For this reason, some modern city office blocks now use white noise to help staff concentrate. It helps to lessen the noise of typewriters, of traffic in the street outside, of the person on the phone near you, and so on. By the same effect, we reasoned that white noise will help you study, or to concentrate on precision tasks.

Don't get us wrong — white noise will not blanket out sound, so if this is what you are looking for, you will be disappointed. But it will help reduce the distraction caused by the TV set in the next room, or the baby screaming next door. The secret is to have the white noise generator going, and then try to forget about it. After 15 minutes or so you should have achieved this and have improved your concentration.

We have mounted the generator on a piece of tagstrip, but it may be constructed any way you like. The layout is not at all critical. And the voltage to run the generator is not critical, either. It may be anything from nine to 25 or so. Once you get above 15 volts, though, change the 680K resistor to one megohm.

As with the tone oscillator, you will need to run the noise generator through an amplifer. The amplifier should have a high sensitivity input such as the input used for electro-magnetic pick-ups.

If you find that you cannot get any white noise output from your loud speakers, it is probably because your amplifier is not sensitive enough for the circuit as shown. In this case, swap the transistor for a BC108 and reverse the battery connections. Our free transistors will give approximately ten millivolts of white noise A BC108 will give approximately 60 millivolts of white noise, which should be enough to drive most audio amplifiers.

NOISE LIMITER . . . cont. from p. 47

volts, it may be operated satisfactorily at up to 20 volts. This means that it can be operated from an 18-volt battery supply or from the mains supply using a 12.6 volt transformer, bridge rectifier and suitable filter capacitor. Current drain of the circuit is approximately 14 milliamps, or 28 milliamps for a two-channel version.

The transistors specified are selected beta types. The BC108B has a beta range of 240 to 500 while the BC108C has a beta range of 450 to 900 at a collector current of 2 milliamps. Two local manufacturers can supply such transistors. STC have the BC108B and BC108C, while Fairchild have the direct equivalents, BC208B and BC208C. Alternatively, normal BC108, BC148 or 2N3565 transistors may be selected for beta using a simple beta tester. The Transistor FET Checker featured in the August 1971 issue of Electronics Australia is ideal for this job.

ANSWERS . . . continued

ENGINE ANALYSER: I am very interested in constructing an automotive engine analyser. Have you ever published, or are you considering publishing, such a project? I feel that something approaching the following specifications would be required: dwell angle, 0 to 90°; rev counter, 0 to 6000; voltage, 0 to 3V and 0 to 16V DC; current up to about 60A DC; ohmmeter. I would appreciate any information or suggestions you may have regarding this project. (R.B., Ipswich, Qld.)

No, R.B., we have not published an engine analyser, and at the moment we have no definite plans along these lines. However, if you want to build up such a unit for yourself, we described a tacho-dwell meter for service stations (File No 3/TM/8) in October, 1964 which would meet the first two requirements. The balance of your specifications can be met by a standard meter with suitable shunts and multipliers. The article mentioned may be obtained through the Information Service for 50c.

MARKETPLACE

FOR SALE

HI-fi equipment. We import famous Lowther speakers and class A amplifiers for music lovers who wan, the best. We also stock Quad, Goodmans, Dual, Jordan Watts, Tandberg, Revox, Sony, Sansui, AWA, Wharfdale, Thorens, Decca Ribbon tweeters etc, etc. Encel HI-FI. For superb fidelity. Duratone, Mail Order, Box 125, Curtin, ACT. Demonstrations, Canberra 81 2549.

FIVE cubic feet DP speaker enclosure $10. Phone 909 1681 (Sydney).

TWO Toshiba speaker enclosures complete, 1 cu ft new — $60 pr. Sydney 649 9178.

PLAYMASTER 127/128 stereo amplifier professionally built. All components top grade. Teak case. $270. 7 Eva Avenue, Redwood Park, SA 64 4023.

MILL engine No 7 an outstanding model. Castings, plans. Bolton, 70 King St., Sydney. Catalogue $1.80.

CRYSTALS for CB 27.240 and 26-785MHz, ¼in pin, miniature, $6 pair, post free. Shalley, 127 York Street, Sydney.

WE SELL construction plans. TELEVISION: 3D convertor, $25 camera, Kinescoping recorder, VTR, color convertor. HOBBYIST: Electron microscope, 96-hour music system, voice typewriter, Morris code to typewriter copier, transistorised teletype. TELEPHONE: Answering machine, pushbutton dialer, phonevision, auto-dialer, telephone extension in your automobile, legal connector. SECURITY: Microphone jammer, voice scrambler, microdot photography. Plans $5.00, air shipped from our USA research labs. COURSES: Telephone engineering $39.50, security electronics $27.50, investigative electronics $22.50. super hobby catalogue air mailed $1.00. Payment accepted in dollars (Australian, New Zealand or US). Don Britton Enterprises, Suite 28, 280 Pitt Street, Sydney, Australia.

BACK issues Electronics Australia stocked, 50c each, prompt service, post free. T. Weir, 56 O'Connor Street, Haberfield, NSW 2045. Phone 798 7569. Wanted to buy copies also.

CABINETS pre-cut kits stereo equipment. Grille fabric, innerbond, accessories available from Robert N. Smallwood, Sound Specialists, 205 Brisbane Rd., Booval, Qld. 4304. Enquiries welcome. Phone 82 1550 anytime.

MARCONI B28 communications receiver needs slight attention. Going order. Appearance good. Best offer. T. N. Fisher "Emby West", Gulargambone. 2828.

TV and transistor service manuals. Operation and valve data instruction book for trion tube tester model T368 or distributors. Address: G. Dent Hopetoun, Vic. 3396.

POWER supply regulated 150mA 350V $20, SCR-211-AL $70, ARC-1 $25, sockets suit 8 IBM boards $2, 12V 522 genemotor $5, 12V universal vib. p/s $15, others, Melb. 232-3626.

NEW TCA HF base transmitter, less output valves 500W AMT150 Superpro receiver. Roberts, 588 Punchbowl Rd., Lakemba, NSW 2195.

DISPLAY ADVERTS in MARKETPLACE are sold in multiples of one inch to a maximum of five inches. Rate $10.00 per inch per insertion, subject to continuity discounts.

CLASSIFIED RATES $1.00 per line per insertion payable in advance. Minimum two lines. A convenient form is provided in each issue.

CLOSING DATE is four weeks prior to the on-sale date. Issues are on-sale the first Monday of each month.

ADDRESS all classified orders, copy, enquiries, etc. to: The Advertising Manager, ELECTRONICS Australia, Box 2728 G.P.O., Sydney 2001.

READER SERVICE

REPAIRS to receivers, transmitters, construction testing; TV alignment, Xtal conv, specialised electronic equip. Eccleston Electronics, 146a Cotham Road, Kew, Vic. Phone 80 3777.

TAPE to disc service. Take advantage of W and G Record's professional experience when next needing a tape to disc service. W and G Record Processing Co, 185 A'Beckett St, Melbourne. Tel. 329 7255.

AUSTRALIAN Tape Recording Society offers tape library, "The Microphone" journal, audio visuals, round robins, tapespondence, sales. Inquiries, PO Box 130, Hornsby, NSW 2077. Please enclose large, stamped envelope.

CATALOGUE of electronics parts. Send 9 x 4 SAE. Micronics, PO Box 175, Randwick, 2031.

WANTED

COMMUNICATIONS receiver, reasonable price, prefer older model Eddystone. Reply Box No 42 New Lambton Post Office, 2305.

MAGNAVOX 363 tape transporter. G. M. Goeby 19/401 Toorak Rd, South Yarra 3141.

CLASSIFIED ADVERTISERS

To the Advertising Manager, ELECTRONICS Australia, Box 2728 G.P.O., Sydney. 2001

- Please insert the following advertisement in the ..... issue
- Tick the classification required

☐ FOR SALE ☐ WANTED ☐ READER SERVICE ☐ POSITIONS

Please write in block letters with ink or ball-point pen. **Number of insertions** .....

Signed: .....

Residential Address .....

..... State .....

- I enclose P. Note / Cheque for $.... being full payment for .... lines at $1.00 per line. (minimum 2 lines)

POSITION VACANT

LICENSED AIRCRAFT RADIO ENGINEER

A vacancy exists for a fully licensed engineer capable of operating a well equipped IFR workshop. Must be experienced in installation and bench work on Communication and Navigational equipment. Commencing salary $5720.

Particulars of experience and licences to:
The Radio Centre
PO Box 36, Archerfield. Qld.

McMURDO ELECTRONIC COMPONENTS (AUST) PTY. LTD

TRAINEE SALES ENGINEER

Due to continued expansion, an interesting position is available on aour staff for a young man 19-24 with a knowledge of Electronics who is interested in entering the challenging field of selling electronic parts. Our customers are leaders in the television and electronics industry. A rewarding career awaits an energetic young man with sufficient knowledge in electronics to be able to talk to engineers and purchasing officers.

Driver's licence necessary. Car allowance. Salary in accordance with experience.

Phone for appointment 807-1977 after 13th January, 1972.

NEW CATALOGUE

Available after 1st January only. This magnificently presented 1972 catalogue will be available for just **$1.00** which is refunded with your first order for **$10.00** or more.

Containing more information and revised price lists, our latest catalogue will be your complete shopping guide to Electronics.

Featuring special sections on HI-FI & disposals, there is something to interest everyone. Send for your copy **NOW.**

PRE-PAK ELECTRONICS
Head office & mail order division, 718 Parramatta Road, Croydon, NSW 2132.
Telephone 797 6144

T. & M. ELECTRONICS

P.O. Box 57, HABERFIELD 2045

BC107	55c	**DIODES**	
BC108	45c	OA91	17c
BC 109	50c	OA95	30c
BF115	60c	OA202	50c
BC177	60c	BA102	90c
BC178	55c	1N4004	35c
BRY39	$1.35	1N4007 (1 amp 1000v)	70c
AC127	80c	BYZ13 6 amp 200v	60c
AC128	70c		
AC127 / 128	$1.50		
AC187 / 188	$1.70		
AD161 / 162	$2.70	**SILICON BRIDGES**	
AD149	$1.50	1A 100v	$1.10
40250	1.90	1A 400v	$1.60
2N2926	65c	2A200V	$2.20
2N3053	$1.30	**ZENERS,** all voltages 3.3 to 33v.	
2N3054	$1.50		
2N3055	$1.60	BZY88 type	55c
mat. pr.	$3.40	1.5 watt type	$1.00
2N5459	$1.00		
MPF105	$1.00	**SCRs**	
2N5485	$1.80	15a 100v	$2.00
OC44-45	40c	(suit power supply prot.)	
OC72	40c		
OCP71	$2.90	15a400v	$3.00
TAA300	$2.85		

Post 15c (SORRY NO C.O.D.)

RETURN MAIL SERVICE

SEMI-CONDUCTOR SPECIALISTS

YOU ARE ONE PERSON IN 211,000 *

. . . As one of the 211,000 regular readers of Electronics Australia, you obviously believe in the reliability and authority of our magazine. After 32 years of continuous publication, Electronics Australia is still Australia's largest circulating and most highly regarded journal in the electronics world. And we have the facts to support it.

Only Electronics Australia has a monthly circulation of over 48,000 copies. This is at least 20% more than any other electronics journal in Australia.

Only Electronics Australia has an average readership in the five major cities of Australia of 211,000. All of them are people with an interest in, or working in, the electronics field.

Only Electronics Australia is surveyed by two nationally regarded independent research companies.

Only Electronics Australia has the experience of 32 years continuous publishing.

Only Electronics Australia has the depth of experience in a fully qualified team of electronic journalists.

*SOURCE: THE McNAIR NATIONAL MAGAZINE READERSHIP SURVEY SYDNEY, BRISBANE, MELBOURNE, ADELAIDE. MAY-SEPTEMBER. 1971.

ELECTRONICS Australia

AUSTRALIA'S RELIABLE ELECTRONICS JOURNAL

Reader Information Service

Here is a convenient and easy way for you to get additional information about products or services advertised in this issue. Just fill out the coupon, stating the information you require, cut out the coupon and post to:

Reader Information Service, ELECTRONICS AUSTRALIA, Box 2728 G.P.O., Sydney 2001

Note: Please list only one advertiser and one product on each coupon.

Post to: **ELECTRONICS AUSTRALIA, Box 2728 GPO, Sydney 2001**

Advertiser .... Page ......

Product ....

Your Name ....

Address ....

.... Postcode ....

Position & Company 1/72

Post to: **ELECTRONICS AUSTRALIA, Box 2728 GPO, Sydney 2001**

Advertiser .... Page ......

Product ....

Your Name ....

Address ....

.... Postcode ....

Position & Company 1/72

Post to: **ELECTRONICS AUSTRALIA, Box 2728 GPO, Sydney 2001**

Advertiser .... Page ......

Product ....

Your Name ....

Address ....

.... Postcode ....

Position & Company 1/72

Post to: **ELECTRONICS AUSTRALIA, Box 2728 GPO, Sydney 2001**

Advertiser .... Page ......

Product ....

Your Name ....

Address ....

.... Postcode ....

Position & Company 1/72

Index to Advertisers

Electronics Australia Privilege offer

SOLID PLEXIGLAS CIGARETTE BOX (with your initials)

for only $9·50 (or $8·50 for the smaller one) post free

These stylish cigarette boxes will sit equally well on a sophisticate's coffee table or an executive's desk. Made in a combination of smoke grey and clear solid acrylic, the boxes will hold 100 cigarettes, or 70 in the smaller size. They measure 7¼" x 4¼" x 2¾", and 4¾" x 4¾" x 2¾". Your initials can be engraved in gold (as illustrated) as a free extra. Just fill in this form, and address it to Electronics (Offer), Box 2728, GPO, Sydney 2001.

CIGARETTE BOX ORDER FORM

NAME . . . . . .

ADDRESS . . . . . .

STATE . . . . . POSTCODE. . . . . .

Please send me . . . . . cigarette box(es)

in the . . . . . (large or small) size.

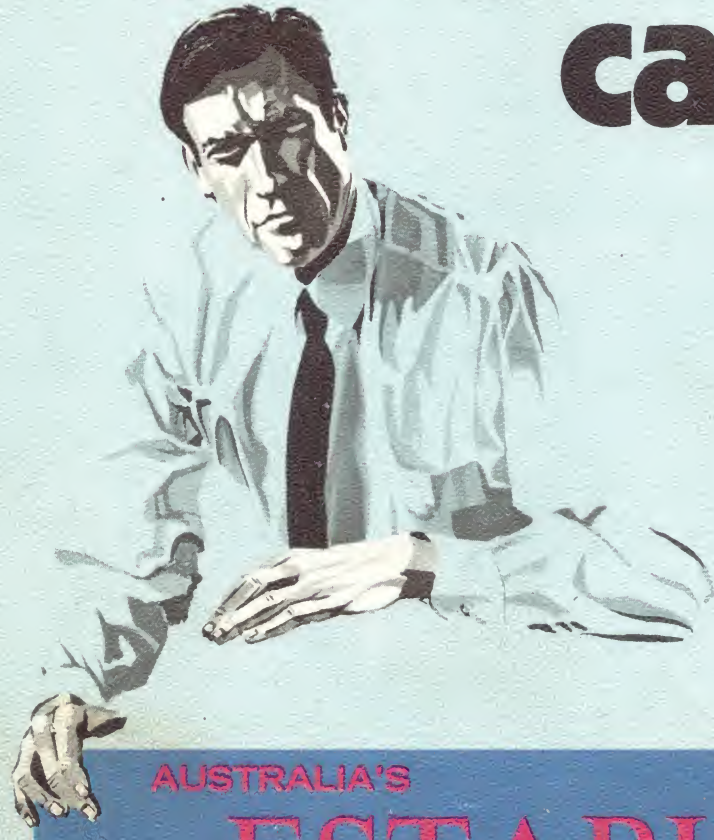
My initials, to be engraved free, are . . . . . .

I enclose . . . . . for . . . . . .

(cheque, money order)

Overseas orders require 70c extra postage.

40,000 Technicians can't be wrong!



- More than 40,000 ambitious men have benefited from A.R.T.C. training.
- Join this large number of successful men!
- Attain job security and financial reward.
- These can only be yours from:

AUSTRALIA'S

ESTABLISHED ELECTRONICS COLLEGE

THE AUSTRALIAN RADIO & TELEVISION COLLEGE PTY. LTD.

- ESTABLISHED OVER 40 YEARS
- OVER 15 FULL TIME STAFF TO ASSIST YOU
- FULL NIGHT-CLASS PRACTICAL LESSONS
  OR
- EXTENSIVE CORRESPONDENCE TRAINING WITH SPECIAL PRACTICAL HOME-TRAINING KITS

Mail Coupon NOW

- You are invited to mail the coupon below which can be your first step towards securing a job or business of your own with good prospects, security and big money. A.R.T.C. will mail to you by return, at no obligation to you the big free booklet: "Careers in Radio and Television". This booklet will show you definite steps you can take for a better job, how you can succeed in life. Post the coupon, phone or call NOW.

AUSTRALIAN RADIO AND TELEVISION COLLEGE

PTY. LTD.

E.S.&A. BANK BUILDING,

Cnr. Broadway and City Road, Sydney.
(Opp. Grace Bros). Phone 211-4244 (3 lines)

AUSTRALIAN RADIO & TELEVISION COLLEGE PTY. LTD.
206 Broadway, Sydney, N.S.W.

Dear Sir,
Please send me, without obligation, your free booklet, "Careers in Radio, TV and Electronics".

NAME.....

ADDRESS.....

.....E201